AGRICULTURAL ENGINEERING

The Journal of the American Society of Agricultural Engineers

JULY 1935

VOL 16 NO 7

NEW "HEAVY CROP" CORN BINDER

Here's a corn binder that's built to "take it" . . . from the tall ear-laden crops in the corn belt to the solid rows of kafir, milo, fodder cane and Sudan in the South. Everything about it reveals substantial construction that assures long and dependable performance. Check these features against old binders: New "sure-tie" knotter with improved crank and packer. Simple steel chain main drive. Self-aligning bearings. Pressure lubrication. Strong suspension type wheels. Enlarged throat room. Open construction with shielded shafts and self-cleaning gears well above the ground . . . no collecting of trash. Perfectly balanced for light draft and easy pulling. Write for advance information on this new horse binder or the equally efficient Case power corn binder with or without wagon elevator.

J. I. CASE CO., Racine, Wis.

CASE

AGRICULTURAL ENGINEERING

Published by the American Society of Agricultural Engineers

Volume 16 | JULY 1935 | Number 7

CONTENTS

Published monthly by the American Society of Agricultural Engineers. Publication office at Benton Harbor, Michigan. Editorial and advertising departments at the headquarters of the Society, St. Joseph, Michigan . . . . Price $3.00 a year, 30 cents a copy; to members $2.00 a year, 20 cent a copy. Postage to countries to which second-class rates do not apply, $1.00 additional . . . . The Society is not responsible for statements and opinions contained in papers published in this journal; they represent the views of the individuals to whom they are credited and are not binding on the Society as a whole . . . . Entered as second-class matter, October 28, 1933, at the post office at Benton Harbor, Michigan, under the Act of August 24, 1912. Additional entry at St. Joseph, Michigan. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921 . . . .

AGRICULTURAL ENGINEERING

VOL 16, NO 7 EDITORIALS JULY 1935

Cities Are Built on the Farm

WHETHER it be a reaction to the duties of the office, inherent in the men we choose for our presidents, or mere accident, it yet happens that for three successive years (to go no farther back) the presidential addresses at annual meetings of the American Society of Agricultural Engineers have stressed the broader social or human responsibilities of engineering in general, and of our own profession in particular.

Professor Glen W. McCuen, as will be seen in his address appearing elsewhere in these pages, emphasizes home conditions on the farm not alone for the sake of farm people, but as the nursery for our city populations. The ofttold tale of the country lad who went to the big city and made good is shown to be not only a matter of individual achievement but of statistical necessity. With a birth rate among city women only about half that of farm women, our cities have made their amazing growth while the rural population, for a generation at least, has stood practically still. In terms of actual farm population the double birth rate probably has accompanied a definite shrinkage.

Not only our food animals, but our sons and daughters, are born and reared on the farm and go to the city for consumption. In the human, as in every other biological phase, the farm is the point of creation and the city the place of destruction. From the individual standpoint, of course, it is immaterial whether the grim reaper overtake a man among the tall corn or among the tall buildings. And it is socially desirable that the city be able to afford a place for the human "farm surplus" not needed in an increasingly efficient agriculture.

But if it be necessary to point out these facts among trained engineers, what of the heedless masses, especially those hurried hordes whose horizon is at the next traffic light? To what degree do they sense that their very existence as an urban entity, let alone their virility in arts, professions, and industry, are a debt to toil and travail among the cows and clods? And if they have no sense of these things, how can they deal intelligently with the agricultural minority on whom they depend for brains and brawn as well as food and fiber?

In this impasse of understanding the profession of agricultural engineering occupies a strategic position, one which imposes on us the role of interpreter. Trained in the actualities of agriculture, social and economic as well as technical, we also are interlocked with the people of the city as neighbors, as sources of equipment and materials, as consumers of farm products. Foreign though it be to our technical habits, we have a duty as propagandists of farm to city, and vice versa.

Educations Exported

IN A TIME when in some quarters animus is being cultivated against what is called a subsidized agriculture, it may help our perspective to draw from the pages of the past an editorial—or a hazy memory thereof—that appeared a dozen or more years ago in the farm journal edited from its founding by the family which twice has given us a Secretary of Agriculture, one of them the incumbent.

It was remarked that some ten thousand graduates from the colleges and universities of Iowa were turned out each year. Most of them went into occupations that took them to large cities, which obviously was taking them out of Iowa. In terms of freedom for self-expression and economic advancement, that calls for no criticism. But to rear and educate each graduate had cost about ten thousand dollars, and it had been done at the expense of Iowa citizens as parents and taxpayers.

Here was an annual crop costing a hundred million dollars, most of which came from the soil. Most of it went as a gift to the cities. No wonder that they thrived and grew apace with these hundred-million-dollar transfusions of choice young blood. Obviously, agriculture was subsidizing the city, but no one was smart enough, or small enough, to build partisan prejudice on it.

Nor is such our purpose here. It is rather to show that, if agriculture is being subsidized now, it is only a token payment on a long-standing debt. In particular, if areas of high wealth and low school-age populations are taxed to support education in regions poorer in dollars and richer in children, it is only a partial repayment. No doubt, especially among ASAE members in educational work, this seems too obvious to need statement.

But it is not obvious among the masses untrained in the economics of education, and apparently not among some of the classes who should be so trained. As liaison officers between city and country, agricultural engineers have here a duty to interpret not the incidence of taxation—others are doing that—but the incidence of its benefits.

The Engineer and the Problem of the Whole

WHEN Assistant Secretary of Agriculture M. L. Wilson, addressing the 29th annual meeting of the American Society of Agricultural Engineers last month, suggested that the methodology of philosophy was needed to supplement that of science in dealing with our national "problem of the whole," he no doubt confronted many engineers with uncharted territory. Indeed, he candidly confessed for himself a sparsity of formal training in philosophy during his student years.

But in emphasizing that there is a problem of the whole in addition to innumerable "problems of the part," he could hardly have chosen a more receptive audience. Again drawing on the flickering spots of memory amid the shadows of forgetfulness we recall a time—about a half-

dozen years ago, at an ASAE Power and Machinery Division meeting in Chicago—when Leonard J. Fletcher (since become a past-president of the Society) arose during a farm management session and declared that we had been using the analytical method long enough, at least as a well-nigh exclusive method. He urged that we use more the method of synthesis; that we devote more attention to putting together the pieces that we had been (and still are) producing at great pains.

If that be philosophy rather than science, we believe that our profession will agree to the need for more philosophy. Admittedly, Mr. Fletcher was speaking in terms of individual farm management. Since then we have arrived at new concepts of agriculture as a whole, and as a part of a still greater whole. But these broader concepts, reaching into the realms of national agricultural administration and of general economic statecraft, find agricultural engineers already acclimated to the synthetic or philosophic viewpoint.

Dr. Wilson also admitted the perplexities that must arise in harmonizing the problem of the whole with our cherished American institutions of individual freedom and opportunity. Again he had not only a sympathetic audience, but one eminently qualified to assist nobly in fitting the parts to the whole. For the essence of harmonizing the whole with the part is to make the national objective economically profitable to the individual, and the engineer is par excellence the inventor of economic methods and machines.

A Changing Tradition

IN THE AWARD of the 1935 Cyrus Hall McCormick Gold Medal to Mr. Theo. Brown, and in his paper in token of the occasion, there is more than poetic fitness that this memorial to the inventor of an epochal farm machine should be bestowed, after a hundred years, on the patentee of a hundred inventions, all but one of them strictly kindred.

Mr. Brown's paper is itself a landmark in the evolution of the profession of agricultural engineering and of its relation to the farm equipment industry. To a degree never before approached, the doors of the experimental department have been rolled back and our profession taken into open confidence. It augurs the end—if the end is not quite yet—of a century of secrecy, a policy that had become a tradition.

We do not imply that trade secrets are at an end. Rather the march of progress has so quickened its pace that the secrets of today are obsolete tomorrow. Our rivalries are not among ourselves alone, or mainly, but with other industries and against time. Competitors we still are, but in ever-greater measure we also are colleagues in solving the puzzles of ever-changing technical and economic demands. We have reached the point where there is more to gain by advancing the industry as a whole than by jockeying for position therein.

Neither do we attach too much weight to the disclosure of detailed experience as among those in the inner circle of an industry. There is too much leakage of information for that. Its major value, it seems to us, is in the inspiration and guidance of younger members of the profession and in the benefits—intangible perhaps—of better understanding by engineers in public research and farm leadership. At the very least it is bound to enhance the *esprit de corps* of the agricultural engineering profession.

The example is now set for engineers of industry to approach the practice of their brethren in public or endowed research by timely publication of findings which may be of general usefulness; indeed, of findings whose use may not be apparent to the finder, but which may fill a gap in some unrelated development.

Despite these advantages, they could not have come to pass without a professional and proper forum. This profession and Society may therefore deem themselves accorded recognition, even as they have been the instrument through which Mr. Brown's "exceptional and meritorious engineering achievement in agriculture" has been recognized.

Our Own Problem of Synthesis

SOMETHING akin to a "problem of the whole" has appeared within the American Society of Agricultural Engineers itself. Never before has there been so much conflict—competition may be the better word—among the concurrent sessions of its technical divisions as was noted, by observation and comment, at the 29th annual meeting. Though this lays down a problem for future program committees, it also serves to emphasize the essential unity of agricultural engineering both as to subject matter and personnel.

Not so long ago the realms of land reclamation and of power and machinery were pretty well separated—hardly tangent, we might say. Now they largely overlap, as was plain enough in the session of the Power and Machinery Division devoted to terracing machinery. On the one hand was a goodly representation of engineers officially classified as reclamation or conservation men. On the other was the trend of discussion by distinctly machinery men into the whole theory, economics, and practice of soil conservation.

Hindsight suggests that this should have been a joint session with the Land Reclamation Division (now the Soil and Water Conservation Division), though it should also be said that the trend of discussion could not be fully foreseen, and that the conservation division already had a heavy schedule. It looks as if our expanding activity calls for less of specialization at our annual meetings, and more of general and joint sessions. For expansion in the narrower phases it seems logical to consider winter meetings by the conservation and rural electric divisions, as has become established custom by the structures and machinery groups.

A similar overlapping and need for joint action is becoming more apparent in the design of building to fit definite systems of crop harvest and processing. Farm electricity long since ceased to be a matter merely of lines and lamps, and spread into feed mills and silage cutters. Pest control is a maverick browsing among tillage methods, harvest machinery, thermal treatment, and electrical devices.

As we get into the broader aspects of regional conservation and development more correlations appear. A hydro installation may not be economic solely as a power source, but may become so by added benefits in the way of flood control, or perhaps of irrigation. Erosion control may be justified by the reservoir silt problem as well as by soil protection. Drainage practice probably will be guided by its influence on stream behavior as well as its control of soil moisture.

In all of this our annual meetings may well be pointed increasingly toward synthesis, or the integration of interlocking subject matter.

Agricultural Engineering Responsibilities[1]

By Glen W. McCuen[2]

THE PAST three years, I believe, have presented problems of greater variety and magnitude than any other period of similar length in the life of the Society; I might further add in the life of our nation. We are now living in an age of great readjustment in which it seems that agricultural engineering has a very definite responsibility.

GLEN W. MCCUEN

During the last decade we have witnessed the pendulum of time swing first to the right side toward progress, then sharply to the left side toward retrogression. In this decade we rose to great heights socially and economically only later to be plunged into the valley of depression from which we are now slowly working our way out. I need but mention these facts in passing for they are so indelibly imprinted on our minds.

Through all this the agricultural engineers, as a rule, have traveled their course with a steady stride, orienting themselves with the compass of clear, conservative thinking. It seems to me that we are now at the place where we can definitely see the responsibilities in all areas of production and living in which we should share in the years to come.

We are at the beginning of a new era. The way is not charted in detail, but the main roads seem to have some definite markings on them. We should plan our programs in such a manner that in ten years from now we will not have to make many major changes in those which we have developed. The influence of our work must not stop at the farm gate. It must be made manifest to a greater degree in all walks of life.

It is quite evident that there are responsibilities for us as a group to assume. I believe the greatest of all responsibilities is one we have toward society in general. The public as a whole is the ultimate beneficiary of our work. We deal with the engineering phases in the coordinated production of the three great essentials of life—food, clothing, and shelter. We have been criticized by the unthinking as having a major part in the drama of the depression caused by so-called overproduction, a much-abused word, but one that caught the ear of the public and caused editors to write caustically about the machinery of agriculture. Let us stop for the moment and compare our agriculture which is mechanized to a greater degree than that of the countries where the agricultural tradition of centuries is followed. Compare our standard of living to the standard of living of the farmers of countries who do not have a machinery problem. I wonder if the public would want to take the risk of a famine every so often, or have plenty all the time.

If it were not for our machinery of agriculture, there would not be any livestock program, for again comparing mechanized and non-mechanized agriculture, we find only a well-rounded-out program of livestock in countries where we have the machinery for greater production per worker.

I feel that it is not presumptuous to say that we have another definite responsibility in making it possible for the maintenance of the life blood of our cities. The work of agricultural engineering must be given consideration in the creation of a better type or kind of agriculture, a better home environment for the people who are to rebuild the life blood of the city. It is a fact that every third or fourth generation of the city family comes to an end as a result of the low birth rate. The city population must be recruited from the rural areas where the birth rate is much higher.

Let us consider for the moment the vital statistics of the different areas we just mentioned. The birth rate of children to each 1000 women who live in cities with a range of population from 2500 and upward, is 286, while in the rural villages it is 471, and on the farm it is 545. The responsibility of our work of cooperating with social science in creating a better home and homestead environment is one that society should consider if we are to be a stable nation in the years to come, for a happy and contented rural population is the very backbone of a nation. Where this phase was neglected in nations of old, we saw a declining culture as well as a ruined commerce.

The genius of the agricultural engineer can make life on the farm a less arduous one, and with the advent of home conveniences, a more pleasant one. Does the public as a whole realize this? We have not energetically publicized the fact that agricultural engineering has a very definite place in the well-being of the social order of the country. We have not fought for our share of credit for the part we have played in bringing about a high type of agriculture, such as no other country on the face of the earth enjoys. People are now willing to lend an attentive ear, and any word spoken will be as the seed which has fallen in good earth. In the past five years the ground was choked with stones and thistles of false ideas. Your president made this observation during the year and one of the most receptive groups that he encountered was at the American Engineering Council annual meeting in Washington last January. And here let me pay tribute to those two members of the Society—Past-Presidents R. W. Trullinger and L. J. Fletcher—who have worked long and diligently in paving the way for this reception. We have at last got the recognition long sought for in this group.

In addition to the responsibilities just mentioned, there are others in the field of education, both in teaching and extension work.

Teaching and Extension. The young men who are being

---

[1]The annual address of the President before the 29th annual meeting of the American Society of Agricultural Engineers, at the University of Georgia, Athens, June 1935.

[2]Professor and head of the agricultural engineering department, Ohio State University. Mem. ASAE. (President of the Society, June 1934 to June 1935.)

trained today are the men who are to assume the responsibilities of tomorrow. The teacher is the builder of the foundation upon which the student erects his engineering superstructure that is finished with the broadening subjects relative to the several areas of living. In this, the teaching profession has a marked responsibility. We must broaden the student's areas of awareness so that he will recognize the value of such training and become cognizant of the social implications of engineering as well as the technical engineering problems.

When we are preparing these men for their life work, we are, as it were, digging in wells for new sources of refreshing knowledge. May I use a biblical reference to illustrate the point I have in mind. In Genesis, we read a description of Isaac digging in the wells that his father Abraham had dug and that had been stopped up by the marauding Philistines. He dug out the old wells and called them by the same names his father had called them. I am wondering if, as we think of this passage, are we not making a parallel case of our own. Our wells, figuratively speaking, have been stopped up by marauding, loose thinkers and others who have no knowledge of the broad scope of agricultural engineering. What are we going to do about our teaching? Are we going to dig new wells or clean out the old ones. Why didn't Isaac dig new wells, if he wanted water for himself and for his cattle? Surely there must have been some progress in the art of digging wells, and Isaac's wells would have had the advantage of at least being more up-to-date and modern. Are we as teachers continuing with the outmoded methods in the field of agricultural engineering education? Are we on fire with the love of yesterday instead of the love of tomorrow where our responsibility rests?

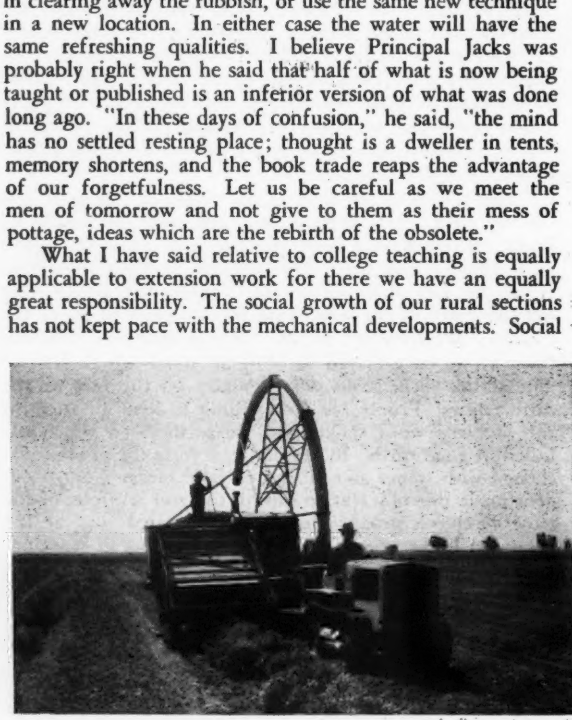
We have, then, two courses to take, as I see it. One is to dig in the old wells of knowledge, using a new technique in clearing away the rubbish, or use the same new technique in a new location. In either case the water will have the same refreshing qualities. I believe Principal Jacks was probably right when he said that half of what is now being taught or published is an inferior version of what was done long ago. "In these days of confusion," he said, "the mind has no settled resting place; thought is a dweller in tents, memory shortens, and the book trade reaps the advantage of our forgetfulness. Let us be careful as we meet the men of tomorrow and not give to them as their mess of pottage, ideas which are the rebirth of the obsolete."

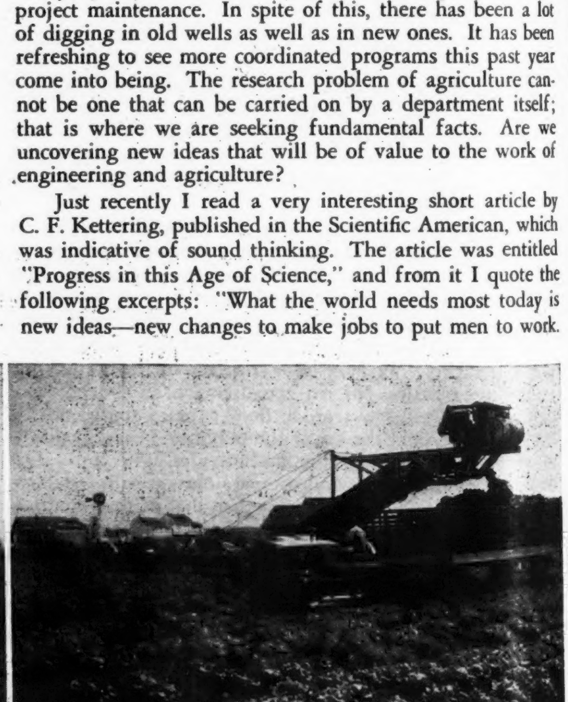
What I have said relative to college teaching is equally applicable to extension work for there we have an equally great responsibility. The social growth of our rural sections has not kept pace with the mechanical developments. Social institutions, such as church and school, in periods of rapid changes have lagged behind. This is not a problem of education for the engineer to handle entirely, but should be a coordinated one out of which will be developed a well-rounded social program. If this will be considered, then the machine which relieves drudgery and gives spare time will be a benefit to society and not a Frankenstein.

Smith-Hughes School Contacts. We have a responsibility in this area. It is here that many a high school student obtains an erroneous conception of what agricultural engineering is. He sees it only as "greasing and fixing," and not as the broad agricultural engineering field. The teacher is not to blame. His training in agricultural engineering has been sadly neglected. He is required by law to take a certain number of hours of professional education. This is fine. He has the wagon for knowledge transfer, but in the majority of cases his knowledge of subject matter of agricultural engineering is just a wee bit down behind the driver's seat. An analysis of the work given by Smith-Hughes teachers will reveal the fact that 40 to 60 per cent of the offerings have as a foundation agricultural engineering, yet the teacher may have had one or possibly two courses in agricultural engineering when a student in college. It behooves the College Division of the Society to continue the study and see that agricultural engineering receives the place it deserves in the curriculum of courses offered in college for the training of teachers for Smith-Hughes work. I suggest that the College Division charge itself with the responsibility of making a determined effort to get more agricultural engineering into the Smith-Hughes college curriculum course. If it cannot be accomplished in four years, maybe five will serve the purpose better.

Research. The seeking for new truths in agricultural engineering has been slowed up somewhat during the past few years due to the lack of funds for both personnel and project maintenance. In spite of this, there has been a lot of digging in old wells as well as in new ones. It has been refreshing to see more coordinated programs this past year come into being. The research problem of agriculture cannot be one that can be carried on by a department itself; that is where we are seeking fundamental facts. Are we uncovering new ideas that will be of value to the work of engineering and agriculture?

Just recently I read a very interesting short article by C. F. Kettering, published in the Scientific American, which was indicative of sound thinking. The article was entitled "Progress in this Age of Science," and from it I quote the following excerpts: "What the world needs most today is new ideas—new changes to make jobs to put men to work.





(Left) The special machine being drawn by the tractor in this picture is used for harvesting the Mexican shrub "guayule" which is grown in the Southwest for its rubber content. (Right) This special machine drawn by a track-type tractor is used to harvest an 1800-acre lettuce crop near Salinas, California. There are twelve cutters working behind the conveyor

"We (agricultural engineers) deal with the engineering phases in the coordinated production of the three great essentials of life—food, clothing, and shelter. Let us . . . . compare our agriculture which is mechanized to a greater degree than that of the countries where the agricultural tradition of centuries is followed. . . . . If it were not for our machinery of agriculture, there would not be any livestock problem, for again comparing mechanized and non-mechanized agriculture, we find only a well-rounded-out program of livestock in countries where we have the machinery for greater production per worker."

One of these days we are going to discover some new fundamental facts which will keep us industrially busy for years. We have been so busy in the past 50 or 60 years applying the every-day use of the fundamental information handed down to us by the great scientists of the past century that we have neglected to continue the work they started. It is time we went back and picked up the job of digging into mountains of fundamental scientific facts where Faraday, Newton, Thompson, Henry, and many others stopped. Some of the recent discoveries in physics and chemistry indicate that this work is already under way.

"In applying these new facts in the future we will have to use more intelligence than we have sometimes done in the past. New things should not be built which will be obsolete before they are paid for. We must plan for change, for change is our only constant. No one can tell what the future will bring, but anyone can foretell that there will be change."

"New ideas" is the keynote of Mr. Kettering's thinking, with the admonition that they be practical for the moment. He does not belittle the fundamental research in any way, however, for many of the commercial successes of today came as a result of some very fundamental research.

The other fact which impressed me was that the only constant we have today is change. It seems rather odd that the things we ordinarily think of as variables are in reality constants.

Land Policy and Buildings. Secretary of Agriculture Wallace made the following statement recently: "There is a great need in the national life today for a continuing agricultural policy, a policy which can be continued through the years no matter who is in power. This need is felt more and more as we develop plans for agricultural adjustment. In this connection the 48 states are individually securing information at the present time to be used by the AAA in the formation of the long-time farming program for the entire country." My understanding is that the information developed by the experiment station in each state is to be used in determining what kind of crops and how much of them should be grown in that state under a plan for an economic agricultural system, that the individual state programs will be combined into a regional plan, and that the regional plans will be combined and coordinated into a national program. The general idea seems to be to work out a system whereby each individual farm and each state may develop its natural resources and use them to the best possible advantage provided such development and use fit into a regional and national plan. An illustration, which I have heard used, of the way in which this plan would work is this: The cotton states may decide that their cotton acreage should be reduced and that the area taken out of cotton should be replaced with corn, which might be an entirely proper regional plan, but as such it might seriously interfere with the development of a regional program in the corn-growing region, thus making it necessary for the regional plans to be coordinated by some central or national agency. This program is to be set up on a long-time basis, but the amount and kind of crops to be raised in any one year will be subject to change on account of physical developments within the various regions and to meet changing economic conditions.

Naturally, we cannot tell whether this program will be adopted, nor can we foresee how effective it might be in controlling the future development of our agricultural resources. Obviously such a program is based on the idea of producing only enough of the various kinds of crops in any one year to meet the requirements of the world for these products at good prices. When you come to consider that the quantity of production is the basis for national agricultural planning, it seems to me that agricultural engineers come quite definitely into the picture, since almost every phase of our work is reflected in crop production and in the storage and processing of farm products.

Irrigation and drainage are undoubtedly factors which must be considered in any plan for the development of our agricultural lands. The engineering features of erosion control are of equal importance in determining whether or not the lands are suitable for agriculture, and with particular reference to this work I think that the fact that the Bureau of Agricultural Engineering has been officially removed from the erosion control picture is but an additional reason why the Society should increase its erosion

control work. I have been impressed with the crops, both as regards locations, quantity, quality, and cost of production. We have not reached the end of this development. New machines and modifications of present ones will continue to have a very large effect upon crop production, and this matter is one which should be given more importance than it has received up to this time by our planning authorities. Farm structures and the processing of farm crops also enter into this kind of planning because the storage of farm products on the farm may be made a part of the final plan and because processing may develop new uses or new demands for farm products. There are other things involved in this agricultural program such as the taking out of cultivation of submarginal lands, and the resettlement of farmers on more productive land than they now have. In these it seems to me that the essential elements are engineering. I admit that those projects have been organized and administered largely from economic and sociological standpoints, and I am personally convinced that the failure to recognize the engineering features of these projects has resulted in placing most of them in dangerous positions.

The reports of the state experiment stations are due September 1, and it is hoped that all of this data can be organized and the program developed shortly thereafter; that is, developed to the point at least where the AAA program for 1936 can be based on the long-time program which probably will be developed rather slowly during the next two or three years. This means that, if agricultural engineering is to be given the consideration which I think it should have in the making of these plans, something must be done immediately. If we do not get busy, these plans are going to be completed before the engineers get to the point where they can demand that proper consideration be given to the engineering phases of planning by the agricultural economists who will be largely responsible for the development of the final plan.

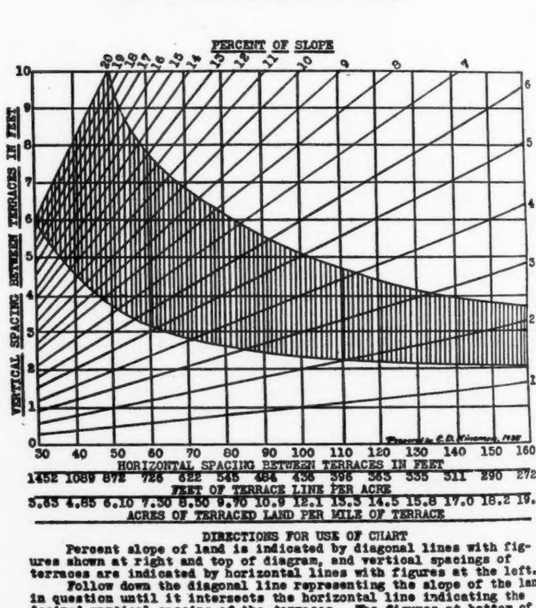
Land is a large heritage of the nation's natural resources. Let the agricultural engineer reach out for his just rights in the maintenance of this heritage and have a definite responsibility in the program of tomorrow's agriculture.

Rural Electrification. Just recently one of my colleagues made, what seems to me, a very pertinent statement, "If land is the heritage of the farmer of the nation, then electricity is his greatest servant." The years of labor, which the Society has so diligently applied in this fascinating field of agricultural engineering, now seem to be approaching the reception which all have looked forward to. It took courage a few years ago to express the fact that rural electrification would be the great field of endeavor of tomorrow. The pioneers in this field worked in the quarries, so to speak, getting out the material for the foundation on which to build one of the greatest national projects in the history of this country. Had not the pioneer workers in this phase taken the fundamentals and formed out of them applications to the many and various needs of the farm, the rural electrification work of today would not have the consideration it is receiving. It is no time to rest—we must continue in the field of endeavor. The committee of the rural electric group, under the guidance of Dr. J. B. Davidson, worked with the American Engineering Council and have secured committment from those in charge of the national work that a definite responsibility for a program of research and extension will soon be placed in the hands of the Society for coordination and execution. The responsibilities for the continuance of the work will be heavy to shoulder, but I know the group will assume the assignment and carry through, ever remembering that whatever is accomplished will be for the betterment of the rural areas which in turn has a direct influence on society as a whole.

Cooperation with Industry. One of the traditions of the Society has been the fine spirit of cooperation which has existed between the manufacturers of agricultural implements and implement accessories and various educational institutions. We have had a mutual responsibility in this field, and through this mutual responsibility both have profited. This has been especially true, through the years just passed, and I hope that nothing of a minor nature will disturb this traditional relationship, for it is through cooperation that we meet together and work out problems relative to the welfare of both. May we continue.

Tomorrow. In closing, I must reiterate that we will have many problems confronting us relative to this year which will have a direct bearing on the years to follow. Our relationship to the various governmental agencies must be given careful consideration, or we may lose our identity and not have a voice in the formulation of the far-reaching program of the readjustment in agriculture. We will have to give and take. We will have to cooperate. If I may again refer to the January meeting of the American Engineering Council held in Washington, it was here that we as agricultural engineers received the greatest opportunity for exerting leadership and challenge the responsibility for tomorrow. It was here that the Council recognized that stability and security rest with a happy, healthy, and more prosperous people in agriculture who with high ideals are looking forward to a greater enjoyment in the most ancient and honorable of the vocations. To keep agriculture on the highest plane in all the civilized world, the engineer has a responsibility. We are equal to it; we must not fail in this responsibility!

TERRACING GUIDE CHART



DIRECTIONS FOR USE OF CHART

Percent slope of land is indicated by diagonal lines with figures shown at right and top of diagram, and vertical spacings of terraces are indicated by horizontal lines with figures at the left.

Follow down the diagonal line representing the slope of the land in question until it intersects the horizontal line indicating the desired vertical spacing of the terraces. The figures at bottom of diagram directly below this point of intersection give the horizontal spacing of the terraces, the feet of terrace per acre of land, and the acres of terraced land per mile of terrace.

The shaded portion includes the range of recommended spacings. Use upper extreme or wider spacings for pasture or hay land in loose soils and the lower extreme for cultivated crop land on tight or impervious soils. Intermediate conditions will come somewhere between these extremes.

This terracing guide chart was prepared by C. D. Kinsman

Preparation of Feeds for Cattle as It Affects Digestibility and Absorption[1]

By E. A. Silver[2]

FOR MANY YEARS feeding trials with livestock have set the standards in regard to best feeding practices. These trials have been conducted with practically all kinds of feeds and with various methods of preparation, such as steaming, boiling, grinding, cutting, crushing, etc. With due respect to the methods adopted in conducting these tests, the results prove at times rather inconsistent. This is undoubtedly due, in large part, to the many variable, uncontrollable factors which are encountered in these tests.

Considerable work has been done both in this country and abroad in gaining information on the physiological viewpoint dealing with the organs and parts within the stomach of the animal. Little information is available dealing with the physical and chemical transformation of food into energy requirements by means of internal manipulation.

Physiological and Anatomical Considerations. The ox possesses the ruminant type of stomach. It is a complex organ consisting of four compartments, namely, rumen, reticulum, omasum, and abomasum. The first three compartments are not true stomachs. They do not secrete any gastric or digestive juices. They are simply pre-stomachs which serve as reservoirs for the food preparatory to passing into the abomasum or true stomach where enzymic digestion begins.

It is the rumen and reticulum that act as the food and water reservoirs. They lie to the left side of the abdominal cavity and freely communicate with one another. It is within these two chambers that the ingesta must be broken down to a certain rather definite fineness before it can pass on in the course of digestion. Their combined capacity ranges from 12 to 18 gal in short yearling cattle and from 30 to 40 gal or possibly more in adult animals. Although there are no real digestive juices or enzymes secreted in these pre-stomachs, they nevertheless have a most important function in the digestion processes involved in the problem we have under consideration. It is in these chambers that the foods are received when first masticated and swallowed by the animal at feeding time. All of the food materials, particularly the roughages which are too coarse to pass into the third and fourth stomachs or compartments, remain here until they are properly processed, and broken down so they can proceed on in the progression of digestion. These processes consist first of mastication where the food receives its first disintegration by the teeth of the animal. This process, in addition to disintegration of the food, is a mixing or moistening process in which the saliva secreted from the salivary glands is delivered to the mouth for moistening purposes. After the food reaches the rumen it may rest there until rumination starts. Visual inspection of the rumen indicates that the food is subjected to nearly a constant rolling action due to advancing and retreating of the muscular pillars of the rumen.

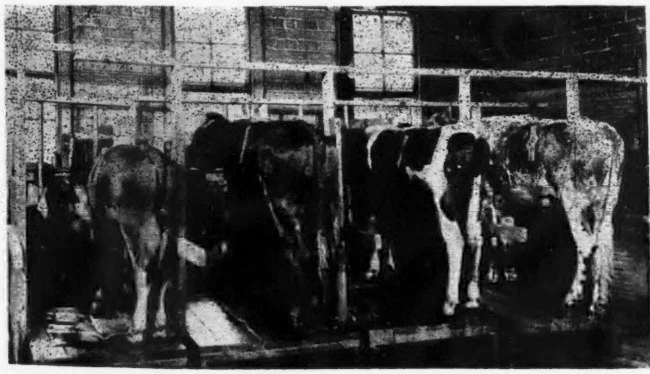
The rumination process is the rechewing of the solid ingesta which is taken back through the esophagus to the mouth, for further disintegration. It also consists of mixing the material more thoroughly with liquids for softening and mastication purposes and fermentation activities which continue ceaselessly in the normal healthy ruminant.

In this research it is desired to learn by comparable trials to what extent, if any, the foregoing physiological processes are influenced or modified by the various forage preparations, viz., cut hay, ground hay, whole hay, etc. In addition, we are interested in time and other factors dealing with mastication, rumination, and ingesta material.

The Gastric Fistula Method. These studies as projected require direct visual inspection of the interior of the ruminant stomach for physiological manifestations as well as specimens of the contained ingesta for physical and chemical determinations at frequent intervals and at definite

[1]Paper presented at a session of the Power and Machinery Division of the American Society of Agricultural Engineers during the 29th annual meeting of the Society at Athens, Georgia, June 1935. (This is a progress report of a cooperative project between the departments of animal industry and nutrition, veterinary science, and agricultural engineering of the Ohio Agricultural Experiment Station. In addition to the author, the cooperators included P. E. Gerlaugh, C. W. Gay, A. F. Schalk, and C. H. Kick.)

[2]Research agricultural engineer, Ohio State University. Mem. ASAE.



(Left) The four animals used in the feeding trials at the Ohio Agricultural Experiment Station, described by Mr. Silver in the accompanying paper. (Right) This view shows one of the animals with fistula opening exposing rumen ingesta

periods. Therefore, the only logical approach to many phases of the problem is by way of the gastric fistula. This part of the problem, together with the supervision of most of the physiological factors of the animals, has been very ably handled by Dr. A. F. Schalk of the veterinary science department at Ohio State University.

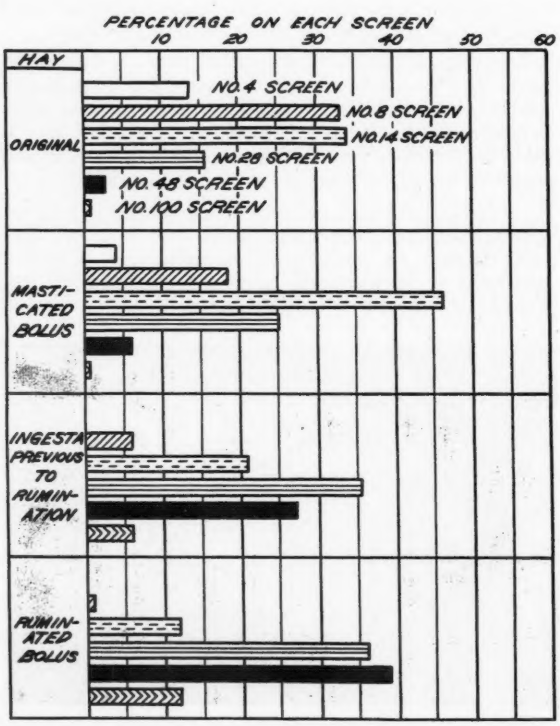
The gastric fistula method has been applied very extensively in the human and dog, and more recently it has found special application in the ox for both physiological and nutritional studies in that species. The left dorso-posteris (upper back) part of the rumen is directly adjacent to the abdominal wall in the left rear flank region where no bony skeleton structures interfere. The fistula is made at this point, as it is the only region where the necessary surgical intervention can be made. In order that liquid ingesta losses may be reduced to a minimum, the fistula is made at the highest possible location in the flank to maintain the highest possible ingesta level, which is at the lowest point of the fistula. The fistula opening can be made of any dimension. They are more or less oval in shape. It must be at least $4\frac{1}{2}$ in in length to provide for easy insertion of the arm.

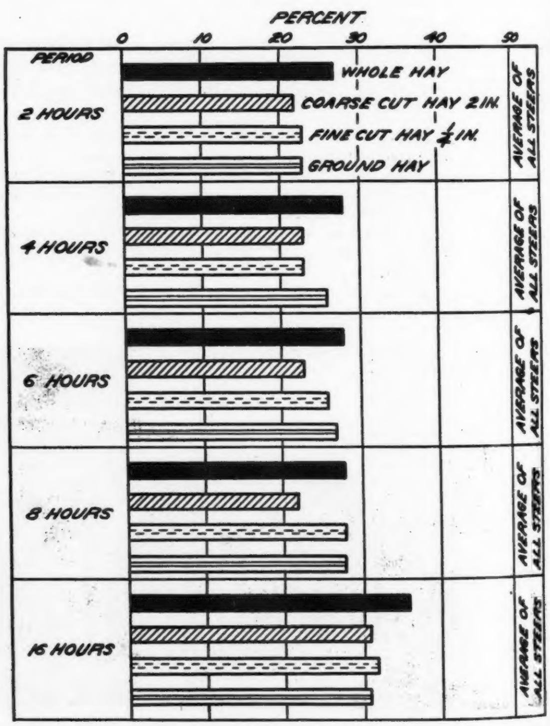
Surgical Technique. Briefly, the technique required in carrying out the surgical procedure is as follows: The animal is fasted for about 24 hr previous to the operation, to reduce the reticula-rumen ingesta to a minimum. The triangular space in the left-flank region is then clipped and shaved and painted with tincture of iodine, the day preceding the operation. Restraint of the animal is carried out in the standing position. Local anaesthetic is preferable to general anaesthetic, as it is efficient, and the animal can be operated on in a standing position, maintaining normal position of the abdominal organs.

A vertical incision is then made, when the rumen will be observed lying adjacent or near to the abdominal wall in practically constant motion. The edges of the body wall are then securely clamped with clamping devices. The rumen wall is then sutured to the skin only. About six to eight days are required for the rumen wall to slough off. Then the opening is left open and healing is usually complete in the course of a few days. To prevent the closing up of the opening a stretcher is inserted for a short period of time. To close the opening so that the ingesta material may be held within the rumen a wooden block is used with a flange of rubberized material on the inside and a wood protector on the outside. More recently, however, one of the rubber manufacturers has cooperated with us in an endeavor to devise a pneumatic rubber plug for this purpose.

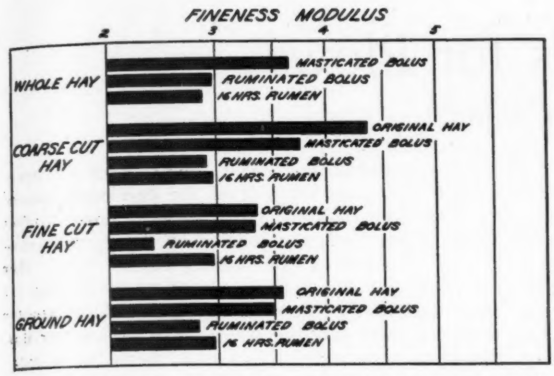
The Experimental Animals. The initial studies in this project involve four beef type steer animals. They ranged in age from approximately six to eighteen months and ranged in weight from 365 to 825 lb at the beginning of the experiment. They were grade animals, and the types compared favorably with those encountered in the average farm feeding lot. Their physical conditions were good, in fact, ideal from a feeding standpoint. In so far as could be determined they were in physiologic balance in every respect. Animals of various ages were selected because of the age factor having a bearing on the results of the work. Feeding trials have occasionally indicated the importance of this factor.

The animals are housed in regular nutrition stalls adapted to this work. In this way there is no chance for the animals to consume other than the feed and water which is given to them. A few times it has been necessary to place the animals in an open lot and to improve their feed ration in order to hold them at the same general physical condition.





(Left) This graph shows the fineness analysis (average of all steers) of coarse-cut hay at various stages of disintegration. (Right) This graph shows the percentage of fine material (that is, material passing through a 28-mesh sieve) in the rumen at various time periods after feeding



This graph shows the disintegration (average of all steers) of hay by the various processes in digestion

All four animals are put on test with the same kind of feed and carried through all the series of tests. They are fed regularly and in most cases allowed all the water they can consume. An attempt is made not to give the animal more food than he cares to consume. In fact they are kept a little short of this amount.

Feeds. The first part of this project includes experiments with alfalfa hay exclusively. This material is prepared in different forms such as coarse cut, fine cut, and ground, with a modulus of fineness of 4.37, 3.37, and 3.18, respectively. All of these preparations are run in conjunction with a series of tests on long hay. The coarse-cut hay is approximately 2 in in length, and the fine-cut 1/4 in in length. The ground hay is processed by a hammer mill equipped with a one-inch screen. Considerably more fine material is found in the ground and fine-cut hay than is found in the long or coarse-cut hay. It is the aim to secure the best quality hay obtainable.

Before each feeding a sample of the hay is retained for complete analysis. In order to thoroughly clean the animals' digestive systems in changing from one type of hay to another, a period of ten days is allowed before analysis is made of the subsequent series of tests.

Mastication. The first process in digestion is mastication or chewing. The degree of mastication can be very well determined by entering the arm through the fistula and retrieving the material (known now as "boli") before it settles into the mass of rumen ingesta. These boli are retrieved for physical and chemical analysis, and are on the average 4 in in length and exceptionally well saturated with saliva. In order to determine the degree of mastication the animal has done on each kind of hay, these boli must be dried to constant weight and a modulus of fineness determination made.

The results of these determinations have brought to light three very important factors:

1 The degree of mastication which each preparation of hay receives by each animal
2 The effect of mastication upon complete mixing of the hay with saliva
3 The degree of mastication as affected by age of animals.

When the degree of mastication on each preparation of hay is considered, some startling discoveries were revealed. The moduli of fineness of the masticated bolus of whole hay was less than that of the coarse-cut hay, even though some of the animals actually did more chewing on the coarse-cut hay. Only a slight degree of mastication was done on the fine-cut and ground hay, although again as much more chewing was actually accomplished on the finely prepared hays as that accomplished on the whole or coarse-cut hay. This is significant in the fact that the animal seems to allow just as much time in the mastication process of finely prepared materials but largely for moistening purposes.

Although we cannot say definitely at this time, nevertheless indications point to the fact that the age of the animal has considerable influence upon the degree of mastication accomplished. In most cases the younger animal showed more activity in mastication with the result that usually a greater disintegration of the feed was accomplished. This point, of course, can be further substantiated when animals of two years or older are used.

Rumen Ingesta and the Rumination Process. Following mastication the food passes into the first stomach or rumen into which the fistula is made. As the material remains in this organ it is subjected to constant rolling and mixing. From analysis made to date further disintegration of the feed takes place within this organ. In practically all cases the rumen ingesta is much disintegrated after a period of 16 hr after the animals have been fed. This of course is due in a great measure to the rechewing or rumination process which practically goes on incessantly from one feeding period to the next. It is of considerable interest to note that through a 16-hr period the whole hay ingesta is finer than either of the other preparations of hay when the average of all steers is taken. This is true even at the 2-hr period after feeding. In some cases at the end of eight hours the ingesta was coarser than at the 2-hr period after feeding. This is undoubtedly due to the fact that the fine material has passed on to the third stomach, leaving the coarser material for further disintegration.

From the data secured, from 12 to 20 per cent of the animal's time is spent in rumination. This data was secured over a 24-hr period. The rumination process is one in which considerable disintegration of the feed takes place. As the ingesta rolls around within the rumen, the rough edges of the material rubbing on the stomach wall seem to inspire the animal toward rumination. This has been exemplified by scratching the stomach wall with the finger nails. In nearly every case the ingesta was broken down practically the same amount regardless of the animal or kind of hay. The following will indicate this:

DISINTEGRATION OF INGESTA BY THE RUMINATION PROCESS
(Measured by Moduli of Fineness)

Process	Whole hay	Coarse cut	Fine cut	Ground
Mastication	3.65	3.75	3.35	3.50
Rumination	2.95	2.90	2.40	2.80
Difference	0.70	0.85	0.95	0.70

Nutrition. Dr. C. H. Kick, who has supervised the nutritional activities of this project, reports as follows: "Crude fiber and crude protein determinations were made on samples of the rumen contents of the four steers and on the hays which were fed. The first samples, taken before feeding and representing the residue from previous feedings, always contained a relatively high percentage of crude fiber and a low percentage of crude protein when compared with the analyses of the hays fed. The second samples, representing a mixture of the hay eaten and the residue in the rumen, contained less crude fiber and more crude protein than the previous sample. The subsequent samples, taken every two hours, showed, in general, a rise in crude fiber content and a reduction in crude protein content of the material the longer it *(Continued on page 270)*

Trash Shields for Plows[1]

By R. H. Wileman[2]

THE NEED for some device or attachment for plows which would enable farmers to completely plow under cornstalks and other crop residues has been recognized for some time. The demand was emphasized as a control measure for the European corn borer which has been responsible for considerable work on the problem by agricultural engineers.

Work on this problem has been in progress for several years in the agricultural engineering department at Purdue University, during which time various shields and attachments for plows have been developed and tested. This work has resulted in the development of a trash shield for wheeled plows which gives nearly perfect coverage of cornstalks and other crop residues.

These shields are constructed of sheet metal shaped to form a hood over the top side of the furrow slice as it is being turned over. The rear edge of the shield is bent down so that it sets perpendicular to the ground surface. This edge is irregular in shape so that it conforms to the contour of the turning furrow slice. The shields are hinged at the lower front corners so that they are free to rise and allow any obstruction to pass under them. They are set so that the top of the shield is as nearly parallel to the turning furrow slice as possible, and yet give the maximum amount of clearance for the trash. This feature has been found to be very important in preventing the bunching of trash in front of the shields and the consequent dumping of it in bunches which cannot be covered. Excessive bobbing of the shields is also prevented by setting the shields at this angle and by hinging them at the lower front corners.

Another advantage of hinging the shields at this point is that the front end of the shield does not move out of position and allow trash to get past it when the rear end of the shield raises up. It is especially important that the portion of the shield immediately back of the jointer does not change its position materially when the shield raises or lowers.

[1]Paper presented at a session of the Power and Machinery Division of the American Society of Agricultural Engineers during the 29th annual meeting of the Society at Athens, Georgia, June 1935.

[2]Experimentalist, machinery of corn borer control, Purdue University. Assoc. Mem. ASAE.

The lower end of the shield extends over the open furrow and just clears the side of the previously turned furrow slice. The stalks or trash are held down by the shield and forced into the bottom of the open furrow immediately in front of the turning furrow slice. The material being plowed under is placed in the bottom of the furrow and covered deep enough so that little trouble is experienced from dragging the trash to the surface during tillage or cultivation. Numerous checks show that, where the plow is cutting 7 in deep, very little trash is found above 4½ to 5 in.

It is essential that the plow be equipped with a good set of rolling coulters and jointers to secure good results from these shields. The rolling coulter must cut the trash ahead of the plow shin and the jointer clean that edge of the furrow slice which when turned over, lies against the previously turned furrow.

The trash is thus thrown under the shield, the back edge of which fits in the groove cut by the jointer. The shield then controls the trash and feeds it into the open furrow just ahead of the turning furrow slice.

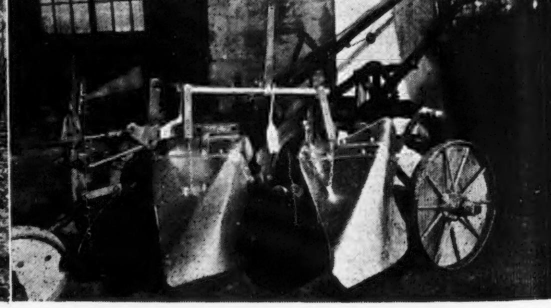
Numerous tests made with these shields show an average coverage of 99.7 per cent in cornstalks, these tests being made without any previous treatment of the stalks except where the corn had been highly ridged. Where the corn was highly ridged, it is necessary to cut the ridges with a disk to level the ground surface so that an even job of plowing and good trash coverage can be secured.

It has been our experience that 14-in or larger plows equipped with these shields enables cornstalks, large weeds, sweet clover, and similar material to be plowed in the fall and nearly perfect coverage obtained. Last fall cornstalks, which yielded as much as 85 bu of corn per acre were plowed under successfully.

Due to the variations in the construction of different plows it is necessary to fit these shields to each make and type of plow.

This is being done for the plows in common use by the agricultural engineering department of Purdue University, and blueprints giving details for constructing these shields are being prepared. These plans are handled as a part of the farm building plan service of the department and are available at small cost. *(Continued on page 286)*

(Left) This picture shows a two-bottom, 14-in plow, equipped with trash shields, turning under cornstalks immediately after the corn had been husked. (Below) A two-bottom plow fitted with trash shields developed by agricultural engineers at Purdue University



The Design and Development of a Farm Implement[1]

By Theo. Brown[2]

Recipient of Cyrus Hall McCormick Gold Medal for 1935

THERE is an important group of workers within the farm equipment industry upon whom rests the responsibility of designing and developing the implements which form the product of that industry. In one plant this group may be known as the "experimental department," while in another it may be called, the "engineering department." However, regardless of its name, in every case its purpose is to keep the product abreast of the times, and to provide for its future development. To be more explicit:

It is the duty of this group to develop new implements for which there is a demand, and adapt current designs of implements to new conditions found in different localities. Then, too, there is always present the more or less routine work of redesigning for strength, economy, and simplicity.

In recent years sound engineering is replacing the more or less cut-and-try methods formerly used. Heat-treated alloy steels and antifriction bearings, as well as the introduction of new processes such as the various types of electric welding, have changed the picture greatly since I first started.

But even now the design and development of farm implements cannot be based entirely upon pure engineering, and probably never can be. With the best of engineering background available for the design of new farm tools, and even after extensive field and laboratory tests have been conducted with the utmost care, troubles will develop that have not shown up before, when the implement is put into use by the purchaser. This is because of the varying conditions found over the country and throughout the world where farm implements are used. When these troubles occur, corrections will have to be made, and these changes must be made quickly if the new implement is to survive.

As to future development, there is a real opportunity in carrying on this important work for a closer cooperation between the experimental departments of the industry and the agricultural experiment stations. One is a natural supplement to the other. The experiment stations have done outstanding work in their search for new knowledge and development of new methods.

The experimental or engineering departments of the industry that are trained to think in terms of the greatest dollar value are then better able to make the most efficient design for meeting all these requirements. We, as agricultural engineers, are interested in the farmer's well-being and should encourage such cooperation.

If I were to treat this subject of the design and development of a farm implement in the abstract, I could not add much to what is already well known. Therefore, rather than try to present a technical treatise, I am going to draw upon the experiences of my thirty-three years' work, and attempt to give you an actual picture of the development of one particular improved farm implement.

And so I am going to take an implement into which I designed and incorporated one particularly novel idea, thus producing a new type of this implement which has been proved out through the years, built in large numbers, and is still in use.

I am going to tell you frankly the story, pointing out the difficulties of design and how they were met; how breakages and troubles were encountered in the field and what was done to overcome them.

This implement is the manure spreader with the beater on the axle, now known as the "John Deere" spreader.

Manure Spreader with the Beater on the Axle. The first commercially successful manure spreader (Fig. 1) was built by Joseph Kemp in 1878. It consisted of a wagon box with a slowly moving bottom which delivered the load rearwardly against a revolving toothed cylinder. This cylinder or beater distributed the manure over the field.

Before the introduction of the Kemp spreader, the only way the farmer had of distributing manure was to load it on a wagon, drive to the field, and spread it from the wagon by hand with a fork.

The Richardson Manufacturing Company bought the rights from Mr. Kemp to produce his manure spreader for

[1]Paper presented at the 29th annual meeting of the American Society of Agricultural Engineers, at Athens, Georgia, June 1935.

[2]Chief, implement research development, Deere and Company. Mem. ASAE.

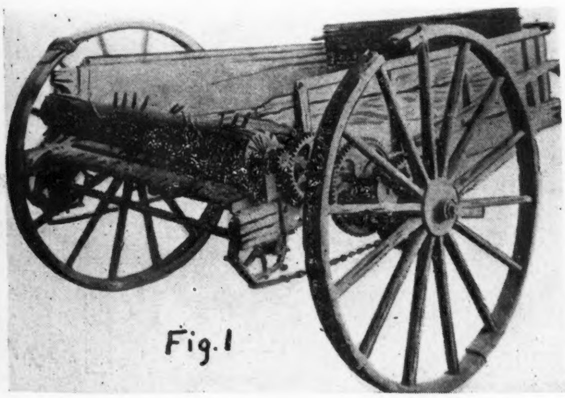


Fig. 1

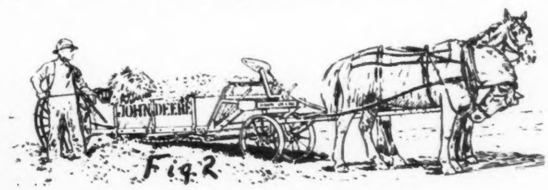


Fig. 2

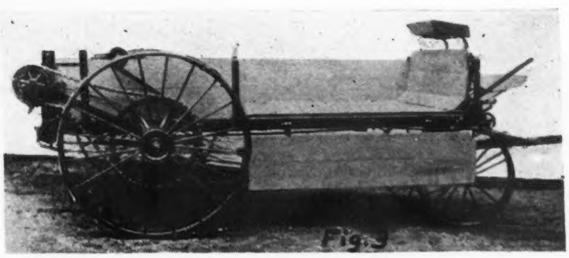


Fig. 3

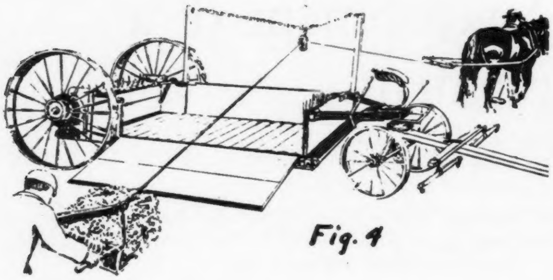


Fig. 4

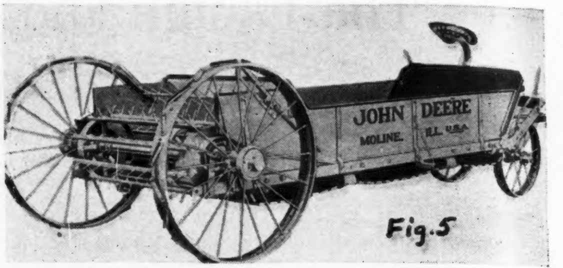


Fig. 5

the New England states, while the Kemp & Burpee Company was organized to supply the balance of the country.

I started to work for the Richardson Manufacturing Company in 1902, and soon afterward began revamping this spreader, which up to that time had been built without much change.

In the redesign of an agricultural implement it is important to have in mind some objective that stands out as particularly desirable, and which in turn helps to create sales. I spent much time in the field observing and studying spreaders, and was more and more impressed as time went on with the amount of physical labor required to load a spreader.

In lifting a forkful of manure the first three feet to place it in the spreader box was not difficult. The real hard work was from this height to the top of the spreader, or, in other words, the real exertion in loading came when the fork reached a point higher than the man's waist (Fig. 2), and the exertion increased gradually in proportion to the height the forkful had to be raised above this point.

And so it seemed to me that it would be particularly desirable to make a spreader that would be easier to load. With this thought in mind, I conceived the idea of hinging the sides of the spreader so that in loading one side of the spreader could be forked in with less exertion.

The side had to be raised before the loading was completed, and loading the rear of the box still had to be over the top. The idea appealed to the trade, and this feature made the "easy loader spreader" (Fig. 3) popular for a number of years. Still, it seemed to me less effort should be required to load a manure spreader, and I kept this objective actively in mind.

So it just happened that one day, looking out the factory window, I saw a drop-axle wagon passing by on which the wagon box was but a few inches above the ground. In some way, looking at that wagon, the idea flashed into my mind, why not build a manure spreader with a box close to the ground like that, getting the axle for the large drive-wheels out of the way by mounting the beater on the axle?

I had been in the habit of making free-hand sketches, mostly in perspective, of new ideas. I still do this, for I find such sketches very helpful in grasping a problem. They give the designer an insight into what may confront him later in carrying forward his project, and are of distinct help in the preliminary work. This method is not a scientific approach to a problem, but every designer must do some dreaming, and this is a good way to photograph the dream.

And so on this day when I saw the drop-axle wagon which caused the new idea to come to me, I made a sketch to see what this new type of spreader might look like. The sketch (Fig. 4) is being shown to you to give an idea of what was in my mind. I did a little more dreaming in this sketch than was developed into actuality later, since I showed a method of loading the spreader too. You will notice that the spreader as sketched shows some resemblance to the finished implement of a later date. However, while I was of course unable to show details of construction, yet the sketch helped visualize what the finished spreader (Fig. 5) might look like, and what problems I was up against.

After a conference, it was decided to lay out a manure spreader incorporating these ideas. While the idea of the beater mounted on the axle came in a flash, the working out of this idea into the practical spreader was a matter of months rather confirming the old adage that "Genius is one per cent inspiration and ninety-nine per cent perspiration." So now the problem was to design a practical spreader using this feature of mounting the beater on the axle and placing the body of the spreader close to the ground.

Since all the machinery of a spreader is driven from the rear axle, and since the beater was to be mounted on the axle, it was evident that here was the place to start. Fig. 6 shows the three elements present at the start—the drive-wheels, the axle, and the beater.

First of all, there must be a frame to support the load of manure, and since this frame was to be close to the ground, the sills had to be in a plane below that of the spreader axle. In Fig. 7 the cross section of the sills are shown in their approximate position. The wheels, of course, had hubs to support the axle. These hubs needed a ratchet connection with the axle in order to rotate the axle. These connections were provided as indicated, on the outer ends of the wheels. Then the frame of the spreader had to be supported by the axle, so axle bearings had to be provided to support the frame. The axle had to be free to turn in these bearings.

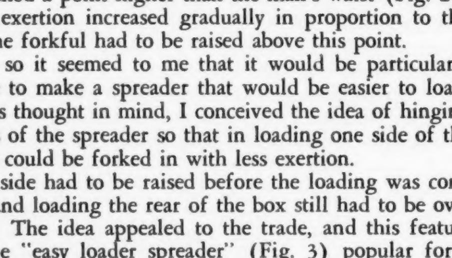


Fig. 6

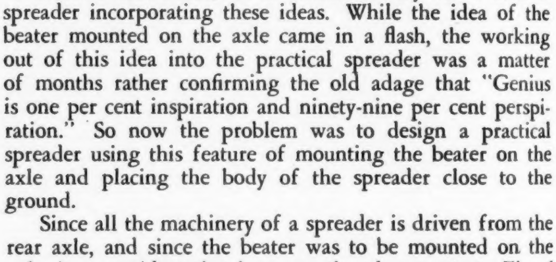
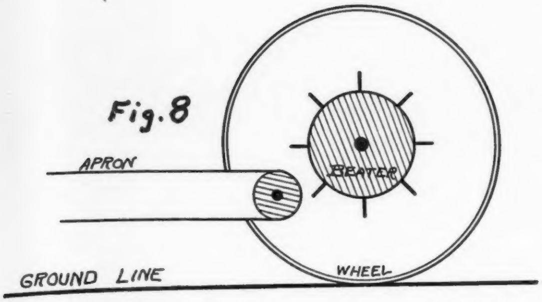


Fig. 7



Now the beater must revolve several times faster in the opposite direction to that of the axle. To insure proper alignment it was essential that the deflection of the axle due to the load, be as slight as possible. The best way was to have the drivewheels as close to the spreader sills and beater as possible; therefore, the wheel hubs were placed adjoining the axle bearings, and the axle bearings occupied all the space up to the beater.

Fig. 7 shows there was no room on the axle for gears and clutches to drive the beater. This was the first obstacle I bumped up against. So as there was no room at either end of the beater, I finally thought of putting the drive within the beater as indicated by the shaded section. This appeared very desirable, but offered difficulties that had to be overcome.

The inside of a beater on a manure spreader is not an ideal place for gears or sprockets, as can well be imagined, and yet the driving mechanism had to be placed there. So finally I hit upon the idea of using a planetary transmission enclosed in a case and running in oil. It was possible with this construction to throw the beater into operation by simply holding the case for the planetary gears from revolving. When the beater was not being driven, the planetary gear case was allowed to revolve slowly.

Next came the difficulty of devising a means of driving the apron or movable bottom. There was no room for gearing on the outside of the beater, so here was another problem to tackle. The first part of this problem was to take power from the rear axle, and the other to apply this power to move the apron. The first half was solved by attaching an eccentric bearing to the outer side of the beater head large enough in diameter to encircle the axle bearing.

Since the body of the spreader was to be close to the ground, it had to be suspended from the rear axle rather than carried upon it. Also, to obviate any binding of the axle, it was necessary to make the axle boxes self-aligning. This was accomplished by using U-shaped straps encircling the axle boxes and attaching to the sills of the body.

Fig. 8 shows the relative position of the movable apron to the beater, and also to the wheels and ground. This relation of parts was a matter of study, placing one advantage against another, and finally striking what seemed to be the best solution.

The wheel base must not be too long for ease in handling. The underside of the endless apron must have sufficient ground clearance, but no more than necessary. The body of manure should come in contact with the beater teeth at an angle to pulverize the load and yet not act as too much of a brake. After this layout was completed, the apron drive design was finished.

I had always been interested in mechanical movements, and used to look through books illustrating many kinds of movements whenever a problem came up where power transmission was involved. In looking through these I saw a device consisting of an internal gear with spur gear running eccentrically used for speed reducing. From this idea I designed a device consisting of an internal gear driven by a non-revolving spur gear carried eccentrically on a driven hub which answered my purpose. This idea lent itself to a very compact and simple drive, reducing the speed from a fast-moving to a very slow-moving part.

A ratchet drive, with varying effective travel of the ratchets, made possible the spreading of different amounts of manure (Fig. 9).

Another point that came up was to get the front wheels as close to coming under the load as possible. A slanting headboard helped to accomplish this result (Fig. 10). The front wheels had to swing around at right angles in order to allow the spreader to be turned short.

When the factory builds a farm implement, it is common practice to erect that implement in shipping bundles rather than as a complete unit. The designer must keep this in mind in his layouts, figuring how the implement can best be shipped, but at the same time it is important that it can be assembled by the dealer on the territory with the least effort and chance of error.

The body of the spreader here presented a problem. It would be too bulky if the sides were shipped in place on the frame. The frame itself must be rigid and must be square and true in order that the apron would run evenly without binding. So a frame had to be designed that would be square and remain so, even without the sides in place.

The frame as shown in Fig. 11 was held square by the

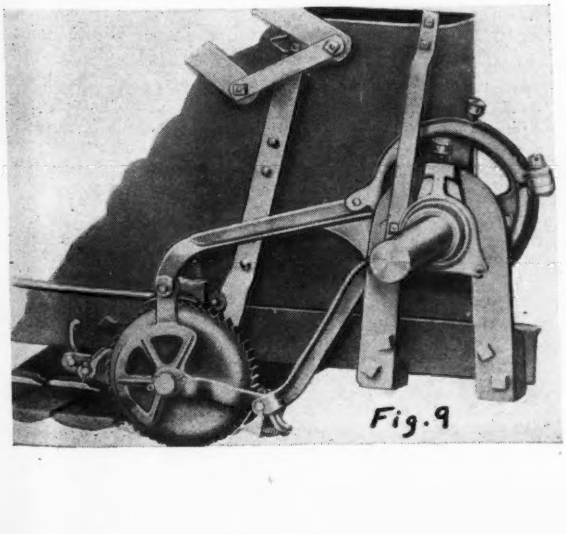


Fig. 9


Fig. 10

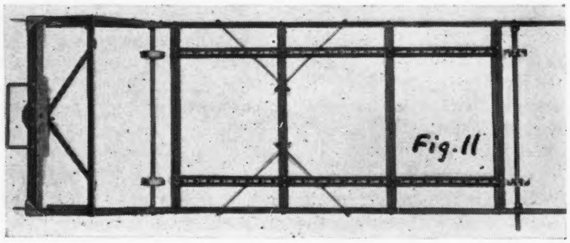


Fig. 11

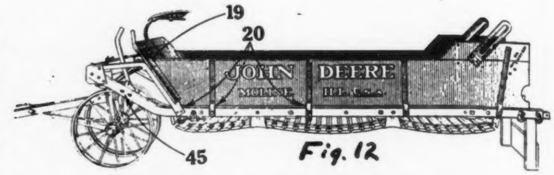


Fig. 12

diagonal truss rods. To insure the frame being square when erecting, a stand was built to hold all the parts in place, and unless the frame was square it could not be gotten out of that stand. This gave an automatic inspection of the frame as to its being square.

The sides of the spreader were assembled and erected on jigs, so with this assurance of accuracy, it was possible to pack them flat in the frame without first having bolted them in place. The one point where error might occur was the joint between the sides and headboard. At this point, for a connection, I used two channels bolted to the headboard so the front ends of the sideboards could fit into these grooves without a fastening of any kind (Fig. 12).

As the beater was mounted on the axle, it was a practical necessity to leave the beater on the axle as a complete assembly (Fig. 13). The question then was as to how this should be shipped.

The idea of placing the two front wheels of the spreader on the rear axle to form protective ends flashed into my mind and was followed by the thought of bolting two wooden crossties between the wheel tires to serve as skids and a protection for the beater. But the axle for the front wheels was smaller in diameter than the rear axle, so the front wheels would not fit. However, the idea seemed too good not to use.

This obstacle was overcome by placing sleeves on the front axle as bearings for the front wheels to run on, and in this way the bore of the front wheel hubs was made a little larger in size than the diameter of the rear axle. An advantage was gained because these sleeves made a very inexpensive replacement part, since the wear from the wheels came upon the sleeves and not on the axle itself.

This idea also saved considerable crating lumber that would otherwise have been necessary. Crating is an expense that must be added to the cost of an implement, but it adds nothing to the usefulness of the machine. This illustrates how a slight change in design can sometimes effect a saving by giving forethought to the way the implement is to be packed and shipped.

At the risk of getting ahead of my story, I am showing (Fig. 14) how the completed spreader was erected in bundles, including the frame with sides and headboard packed flat together, and also the complete beater assembly including front wheels and skids.

The success of an implement depends to a large extent upon the thoroughness of its design and development, and it may be in order here to say something about how desirable it is to strive for simplicity in design.

It takes time, study, and hard work to produce simplicity, but nowhere can effort be spent to better advantage. It is not difficult to make a complicated device, but it is a triumph to make a simple one. Then, too, simple parts can be made to better advantage, and with greater accuracy and economy.

Neither should a designer be satisfied with an awkward or grotesque structure, for there is great sales appeal in good lines and proportion, and much to be gained by having something pleasing to the eye.

Also, a designer should be original in his ideas, but not impractical. Imitation is the sincerest form of flattery, so he should strive to be imitated rather than to copy. Then too, the path of the copier is a hard one, as he may infringe patents already issued, or be in danger from pending cases that have not yet been issued, but which will later be found to cover the structure. So, besides being a trailer, he may face patent litigation.

Since implements are erected in shipping bundles, as previously stated, and since these bundles are usually painted by immersing in a paint dip, it is possible to gain attractiveness and general appearance by a good color combination. It is reported that Henry Ford once said, "The Model T would be painted in any color so long as it was black." The same in former days might also have been said of farm implements, except that the color was then red instead of black. It is possible to paint the various shipping bundles different colors, and so relieve the monotony of having the finished implement all one color.

While lumber is not used today to the extent it formerly was in implement manufacture, it still has its place, and the designer should confine his specifications to commercial sizes. For instance, the pole for the spreader was designed to get two poles from a 3x7-in cross-section plank by sawing the plank on a diagonal line. The slats for the endless apron were finally made narrower than originally planned in order to take advantage of a certain mill-run size of yellow pine lumber.

The foregoing rather briefly covers some of the problems of design I encountered. At length, when the design was completed and patterns made, the first experimental spreader was assembled, and tried out in the field. Deere and Company became interested then, and ordered a number built. After placing them in the territory to find out how the trade would react, they decided to acquire the patents, and the scene shifted to Moline.

In the meantime I had signed a contract to work for

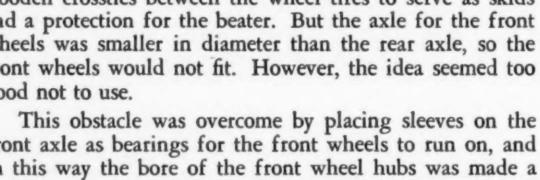


Fig. 13

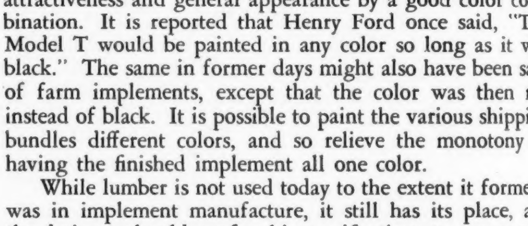


Fig. 14

Fig. 15

Deere and Company, so in November, 1911, a complete redesign of the spreader was started, and work was pushed along vigorously to get ready for production at as early a date as possible.

A few troubles had developed in the field with the first spreaders built. The method of setting the beater in motion by stopping the case from revolving, consisted of a stop fulcrumed to rest flat against lugs on the side of the case. This device was found to act as a wedge, causing a bind sideways and resulting in sliding of the drivewheels and some breakage of transmission gears. So, in the new design, a cushioned stop was incorporated. This stop worked at right angles to the one formerly used, thus obviating any chance of side bind. A coil spring (Fig. 15) cushioned the starting impact.

It was then decided to strengthen the transmission. Increasing the size of the transmission gears meant increasing the diameter of the transmission case. But the outside of the beater was to be left the same diameter, and so the only chance was to discard the wooden beater bars and use a bar of less than one-half its thickness in order to place the gear case within the beater. But the strength of the bars must not be tampered with. A steel U-bar section, such as used on harrows, was found to be stronger and stiffer than the wooden bars, and of a section small enough to allow clearance for the larger transmission case. The teeth were inserted in these U-bars with a shoulder on both sides of the bar, and never came loose (Fig. 16). These teeth were designed so that they could be made on an automatic machine, shouldered and cut off at the rate of 52 a minute.

The beater heads to which the beater bars were bolted were at first designed to be constructed of cast iron (Fig. 17). However, later it was found that there was some breakage of these heads, particularly in shipping. A new type of beater head was designed using a cast iron hub with steel spokes and outer rim (Fig. 18).

To test the comparative strength of the new and old designs, two complete beater shipping assemblies were dropped twenty feet to a hard earth surface. The bundle

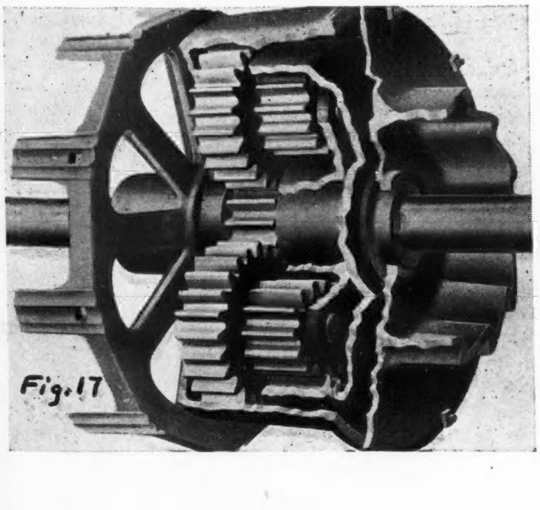


Fig. 17

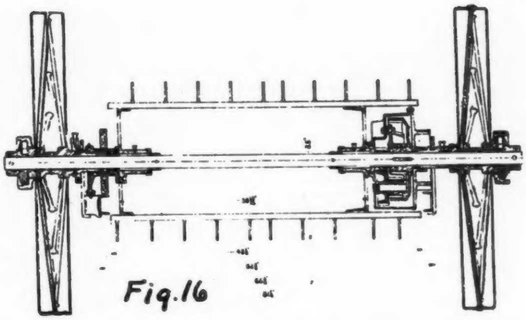


Fig. 16

with cast iron heads suffered breakage of both of these castings, while the assembly with the beater heads constructed with steel spokes and rim was not damaged.

At length, early in January 1912, the first experimental spreader was ready for trial. It was cold work trying out this spreader with temperatures running below zero, but under these conditions it was possible to give a severe test. This test was successful and then it was decided to build thirty more spreaders as soon as possible. In February the thirty were sent to Kansas for immediate sale and use.

The following April the first of the regular run was finished. At that time manufacture was on the basis of ten spreaders a day. In a month more the production was increased to fifty spreaders a day, and two months later it was still further increased to one hundred per day. This was pushing production to the limit, but the demand existed and orders were filled.

Jigs and erecting forms were designed and built, and there was never a complaint that spreaders did not go together perfectly when set up by the dealer. These jigs were carefully thought out so that they acted as automatic inspectors. If the piece was not right, it would not fit in this jig to start with. A run-off stand was provided for operating the completed rear axle. It was arranged so that the axle would not go in place unless all parts were right. The axle was driven by a motor and a brake imposed on what corresponded to the apron drive. In this way the whole assembly was operated under full load for about fifteen minutes.

It is most important that the implement goes to the trade in perfect shape. The more automatic inspections the various parts undergo, the better chance there is to avoid error.

As with all new implements, some troubles were bound to develop in the field. The success or failure of new implements often depends upon the speed and ability to correct field troubles as soon as they appear. It is evident if troubles get too much of a start, it is almost impossible to get the better of them, and the implement may prove a failure. It taxes the ingenuity of the implement designer to the utmost to successfully meet such emergencies. It means making a swift and correct diagnosis of the trouble,

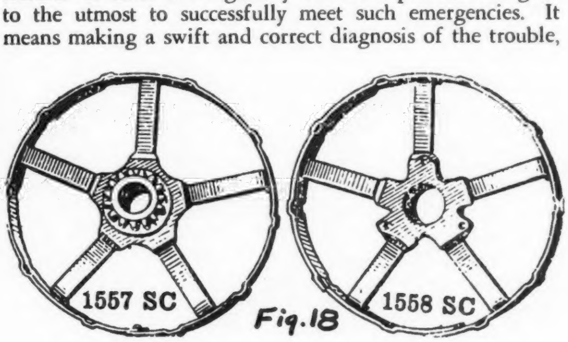


Fig. 18

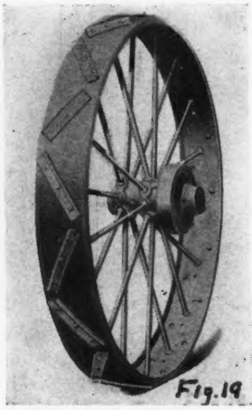


Fig. 19

devising a practical remedy with the least change in design that can be put into production at once and can be applied to implements in the field.

And various troubles and weaknesses did develop in the field, which was only natural when so big a job was put through in so short a time. With 100 spreaders being built a day, it can be appreciated how imperative it was to get these troubles and weaknesses corrected as soon as they were reported.

One of the first complaints to come in was that the spreader tended to skid to one side. This was found to have been occasioned by the fact that the cleats on the drive-wheels angled in one direction only. I had designed the drivewheels and ratchets so that they were interchangeable right or left, for I remembered once making a long trip to correct a complaint only to find out that the right-hand wheel was on the left-hand side. So, rather than go to right and left-hand wheels with opposite angled lugs, it was decided to angle the lugs first right and then left (Fig. 19). This kept the wheels interchangeable and cured that trouble.

Next, the pawls in the ratchets for driving the rear axle started breaking and splitting open the holders. It was found that some of the pawls did not seat themselves properly in their holders, and the pawls wedged in the ratchets. Immediately steel castings were substituted for the malleable pawls, and drop forgings were used as soon as they could be procured (Fig. 20). This and a change in the design of seating of the pawls cured this breakage.

Then there was another trouble. With the heavy loads travelling over rough ground, the malleable iron front corner brackets sometimes cracked open in the corners and there was danger of the front bolster pulling out. Here was a case where a new part had to be made interchangable with the old, and to do so it was necessary to substitute stronger material. The answer here was a high carbon steel plate blanked to size, and formed to shape under a drop hammer. This ended that difficulty.

A complaint was brought in that the aprons (Fig. 21) did not run true in the frame, and tended to run to one side. The chains to which the apron slats were riveted were made of malleable iron castings. Since there were about 120 links in each chain, any error multiplied, so a variation in the lengths of different chains was not uncommon. A pronounced difference in the lengths of the two chains on an apron caused the apron to bear to one side. A pressed steel link was designed and semi-automatic machinery built to make these links. These links were always uniform, and aprons built with them ran true.

Another complaint was that rear axles broke through the half moon key slot. A close examination showed that the axles developed a fracture starting at the bottom of the key slot and running in a spiral direction around the axle. It was concluded that this must be caused by crystallization, and this in turn was due to vibration. In this case a change of material cured the trouble. The axles had been cold-drawn Bessemer steel. Open-hearth steel (40-50 carbon made from selected chipped and cropped billets) was substituted and axles made from this steel never broke.

Far the most serious trouble encountered—one that

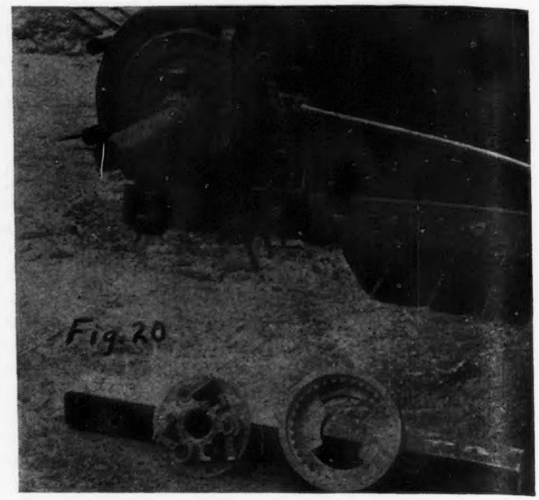


Fig. 20

threatened calamity if not cured—was when transmission cases and gears were reported breaking. A shipment of one hundred broken cases was sent to the factory. Here was trouble aplenty, and the future of the spreader was at stake. I set everything aside to diagnose this trouble.

I examined every part of every transmission and noted down any peculiarity and made a minute description of each break. Then, grouping all this information together, I made a classification and found a certain similarity in the breakages. It looked as though the internal gear had teeth with not enough clearance at the out end, and that there were small lumps on some of the step gears. This caused a bind on the spider casting holding the step gears. This bind caused a break at the foot end of the spider, and this broken part fell into the gear teeth, cracking the internal gear and sometimes the case itself.

Here was a situation that demanded a positive cure. Corrections must be sufficient to make sure that gear cases would never fail, and these changes must be put there at once. So, patterns were checked and strengthened, gear teeth were given more clearance, and ends rounded. A foundry expert developed a semi-steel for the step gears and a process for annealing them after casting. An apparatus was constructed overnight to make a drop test on the teeth of the step gears. It was found by this drop test that the teeth of the semi-steel gears were much tougher. The falling weight had to be raised very much higher before the semi-steel teeth broke. A standard height was set from which the weight must drop without breaking the teeth. Samples from every day's castings were checked, and unless these samples met the prescribed test, the whole lot was rejected. Ring gear gauges were made, through which each gear had to pass, and a master pinion was tried in every internal gear. Every stud for gears was checked for concentricity of threaded end.

Within a few days transmission cases were being built with all these changes and tests in effect. After this there was no further trouble with transmission cases.

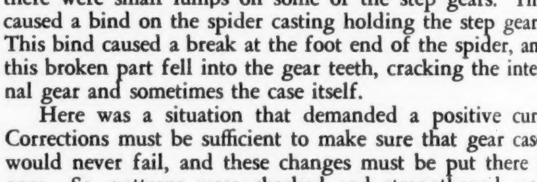


Fig. 21

It would be impossible to go into all the changes that were made from the start to the time when the spreader with the beater on the axle reached the point where complaints and troubles virtually ceased. But the various troubles I have told you about give an idea of what the designer is up against until the time is reached when an implement goes out from the factory with the certainty that it will stand up to its work.

Since the beginning this spreader has been in continuous heavy production. If the details had not been watched so carefully, and troubles ovecome as soon as they appeared, this story of the spreader with the beater on the axle might have had a very different ending. No detail in the design and development of a farm implement is unimportant. It is a matter of taking infinite pains to make one that is successful.

In this story I have tried to point out the essentials of implement design and development by using actual examples. It may be of interest to summarize these briefly:

1 The idea, or feature, which must have merit.

2 The preliminary layout, incorporating the relation of component parts.

3 A careful consideration of available shop equipment.

4 A continual striving for simplicity of parts and assemblies.

5 A cost analysis as the design proceeds.

6 Consideration of ease and accuracy of erection, both in the factory and in the field.

7 Method of erection in shipping bundles.

8 Field and laboratory tests.

9 Ability to overcome troubles as they are encountered.

All these points, if given proper consideration, should create a design of implement satisfactory to the user, the dealer, and the manufacturer.

And now a word as to the future. About sixty years ago a young man, who later became an eminent patent attorney, hesitated to enter that profession because, after making a trip to Washington, he was advised that everything worth while had already been invented, and so there was no future for a patent lawyer.

What a different viewpoint we hold today as agricultural engineers! We know that we are still in a period of pioneering in the developing of new types and methods of performing farm tasks with machinery. We know that we have greater opportunities than ever before to benefit the farmer because of the wider use of mechanical power, new materials, new conceptions of the conservation of water and soil, new crops, new industrial or non-stomach uses for crops and the like.

What a field we have before us! What opportunities! What problems waiting to be solved! We agricultural engineers have a wonderful future, and it is up to us to make the most of these opportunities.

Discussion by Oliver B. Zimmerman[3]

IN HIS PAPER Mr. Brown has been more than candid; he has actually emphasized the problems which arise and demand prompt solution after a design is in active production and sale. This should lend encouragement to younger designers who may take too much to heart the need for such changes in their work. I think it should be emphasized that sudden problems or gradual opportunities for improvement do not necessarily, or even commonly, imply oversight by the designers.

While it goes without saying that such changes should be anticipated and held to a minimum by forethought, nevertheless there are so many changes in governing conditions which cannot possibly be foreseen that ability to effect changes promptly is a major virtue, in designer and factory alike. When the spreader was originally designed, or even redesigned, there was little prospect of its practical use with other than traditional power—a pair or perhaps three of horses with a working speed of 1¾ miles an hour. Now, in an imperceptibly gradual adoption of mechanical power, that speed is doubled and trebled, with inertia stresses increased in still higher ratio.

At the same time, spreading ceased to be a fair-weather job and, with the machine taking the grief, became a year-round operation including work on frozen ground, perhaps with partly frozen material to handle. The conditions were far more severe than the designer could foresee, and even if he could have foreseen them, it would have not been economically justifiable to build for them in advance of their arrival. Indeed, it does the designer much credit when he can effect his improvements out of the economies made possible by experience and quantity production, thereby giving the farmer a superior machine without change in prices.

Thus it is, on the occasion when we honor him as an inventor, that Mr. Brown addresses us as an engineer. For while an invention once made stays made, the design embodying that invention is something progressive, developing in relation to manufacturing, shipping, sales, and service conditions.

[3]Agricultural and mechanical consulting engineer. Hon. Mem. ASAE.

More Farm Building Needed

IT IS HIGHLY desirable that much more extensive and definite research and study be made on farm structures problems. Agricultural engineering research and extension in our agricultural colleges should be reinforced, and county agents should be urged to give more time and effort to farm structures. County agents as a rule are selected for their knowledge of the production of crops and live stock, and they have little or no training in building problems. Observation of the last ten years of agricultural progress quite bears out this statement.

It must be recognized that it is not possible to make sufficient profit on farm products to pay for new buildings in a few years time, and to be profitable, buildings should be erected that will last over a long period of time, 50 to 100 years at least. This very often necessitates long-time, low-rate loans, possibly with renewal privileges. It is of course realized that many inefficient farmers will not be able to negotiate loans. They will benefit, however, by the rise in prices of their products, and they may be able to find extra work at good pay helping neighbor farmers who are able to build or repair their buildings.

Agricultural experiment stations and colleges should be requested to direct more of their energies and funds to agricultural engineering projects, such as farm improvements, buildings, fences, silos, water systems, drainage, so'l erosion, etc., thus assisting in a consumption program as well as in a production program. They should also be urged to establish short courses in farm structures for the benefit of farmers and country builders, provide agricultural engineers as speakers for public meetings and furnish bulletins and building plans to farmers who contemplate building improvements.—WM. BOSS

Present Opportunities for Better Farm Building[1]

By K. J. T. Ekblaw[2]

THE CONDITION of our farm structures has been a matter of discussion and criticism from the time the first of our buildings were put up, I suspect. Perfect buildings have probably never been erected and probably never will be. When the first farmer put up his first farm building, very probably he immediately began to see faults in it and to make plans for correcting those faults in similar buildings with which he might have to do in the future. That same condition has been true all through the years; it has been much like the condition of the weather about which, as Mark Twain remarked, people talked a great deal but seemed to do very little.

However, it does seem as if the farm buildings of this country really are worth serious consideration. According to the 1930 census their value was $12,949,993,774. That is certainly an imposing figure. Any investment of almost 13 billion dollars is certainly worthy of the most careful consideration. I wonder if there is any investment of a similar amount that gets less real thoughtful attention than does this tremendous investment in American farm buildings.

In talking about promoting better building I use the term "promoting" advisedly. I realize that in some circles, and especially in academic ones, the term "promote" bears a connotation of opprobrium; but I say without reservation that we should promote better farm buildings, and I have the dictionary to help me justify my statement, because the term "promote" can mean not the questionable activity which is sometimes so irritating, but a contribution to the development, the fostering, the encouraging, the raising to a higher standard. There certainly is opportunity to contribute to the development of farm buildings. There certainly is opportunity to foster and encourage such development, and likewise there is an opportunity to raise the standard of farm building construction.

Building Rehabilitation a Many-Sided Problem

We can view this matter of farm buildings from a number of angles. First, let us consider *time,* especially the position of the present years in an economic period or cycle. Everyone knows that agriculture began to slip into a depressed condition about fifteen years ago, when the first hard times came following the war. Ever since that time farm buildings have been neglected. They have deteriorated steadily; their rate of deterioration has increased as the years went by. Now many farm buildings are in such a bad condition that it is best to let them proceed to utter collapse. With many others there may a question as to the value of repair. Many of them, of course, still are not beyond hope, but action will have to be taken regarding them soon if further and greater loss is not to be involved.

Through the decade from 1920 to 1930 farmers in general let their buildings go, making only minor and most necessary repairs, hoping against hope that times would become better, that income would be great enough to permit of the expenditure of some major sums for the repair and rehabilitation of their buildings. Then came the final dive into the depths of the depression, and for a while it seemed as if no hope remained.

More recently there have been things happening which justifiably make the farmers believe that perhaps all is not lost. That thin, brilliant border around the edge of the cloud is getting a little wider and a little more convincing. Perhaps there is a silver lining after all.

Economies Possible Under Depressed Conditions

More than one shrewd business man, making careful analysis of financial and economic conditions, has come to the conclusion that the time to replace physical equipment and put it into shipshape condition is during a time of depression. I have seen this policy carried out in a number of instances with factories, department stores, banks, hospitals, office buildings, and in most cases the policy has been thoroughly justified.

It is not difficult to see why this should be true. In any industrial expenditure, labor and materials constitute the major portion of the expense. When times are hard, when a depression is on, and when competition is beginning to get in its work, the price of labor and materials generally shrinks. Anyone who is in a position then to buy labor and materials can buy them very advantageously, as compared with the price of those commodities when times are better and when competition means that there is bidding for both of them. There is all the difference in the world between a buyer's market and a seller's market.

What is true of other industries certainly can be true of agriculture. Certainly now is the time to get labor at a fair rate, unless the unions insist on too high wages. Likewise, prices of most materials are low because labor enters into their production. Moreover, economy in the cost of labor and materials is not the only thing that can be achieved, for that same reduction of rate goes through all the phases of building activity from the design and advisory service down to the inspection of the completed structure.

A second viewpoint is that of *experience.* True, the acquisition of experience never ceases and we can expect that the experience which we will gain in the next decade or two probably will enable us to build better buildings than we can right now with the experience which we have behind us. Nevertheless, we do have a wealth of experience behind us, and because we have been compelled to go rather slowly, to consider things rather carefully, we may be able right now to make better use of the experience which we have gained in the past than we would in prosperous times when things might be moving so fast that we would not have time to think.

Still another viewpoint of major importance right now is that of *finance and investment.* Farm buildings cost money. The figures which I quoted at the beginning of this paper indicate that the average investment in farm buildings in the United States is over $2,000 per farm, or roughly speaking, approxmiately 25 per cent of the value of the farm land. As many a farmer knows from experience, it is not the easiest thing in the world to get money with which to

---

[1]Paper presented at the 29th annual meeting of the American Society of Agricultural Engineers, at Athens, Georgia, June 1935.

[2]Agricultural engineer, American Zinc Institute. Mem. ASAE.

erect or repair buildings, or at least that has been true in past years. Right now, perhaps, the farmer is in a better position in this respect than he has been for a long time. Through various government agencies it is possible to get money under favorable terms for building repair and replacement. Private agencies perhaps are not so friendly with their loans but the fact remains that financial stringency so far as loans are concerned has become considerably reduced and banks and other lending agencies are disposed to look upon requests for loans for farm buildings with more leniency.

Credit Conditions Show Improvement

Of course, the investment angle is so closely tied up with the financial angle that the two must be considered together, and perhaps the reason that it is easier to get loans now is because it is easier to demonstrate that farm buildings as an investment are more likely to pay a fair return than has been the case in some recent years. Farmers who have maintained a satisfactory degree of credit during depressed times are finding it not impossible to borrow money for building purposes, and instances of where such transactions are being carried through are not at all uncommon at the present time.

A fourth factor to consider is that of the *function* of the buildings. Most farm buildings can be classified either as homes or as storage buildings for crops or as shelters for livestock and equipment. Right now there is a great deal of interest in farm homes and justifiably so. The American farmer feels that he has a right to maintain an adequate standard of living, and one of the essential factors in such a standard is adequate housing. Fifty years ago I believe it would have been true to have said that the average farm home was inferior to the average town home. I doubt very much whether this is true at the present time. Advances in rural home design, construction, and equipment certainly have been made and are being made at a rather rapid rate, and the widest opportunity exists for making even greater advances in this direction.

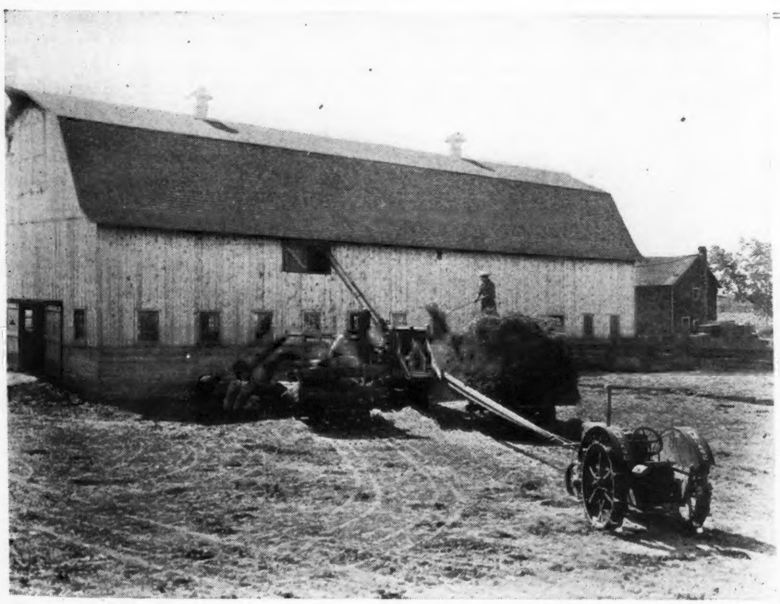
In the past it has been taken as a matter of fact that the average city dweller should have certain so-called conveniences, meaning adequate, convenient light, water supply, sanitation, and heat. So far as farm life was concerned, these conveniences were conspicuous more by their absence than anything else. Now, however, they are coming to be very much the rule, and probably another decade or two will see them standard in farm homes.

The function of storage buildings and shelters is coming to be more clearly understood and definitely appreciated than ever before. With this better understanding and appreciation comes improved efficiency, but whether the farmer has realized the advantage of this improved efficiency is a question. Certainly in many sections of the country there has been but little indication of it. In many ways the buildings which are found on the majority of American farms are too much like the buildings of a hundred years ago.

Is Building Permanence Always Desirable?

A fifth viewpoint of vital importance is that of the type of *materials* used in building construction. In this connection I want to raise a question as to whether we are entirely justified in promoting the idea of permanence in building construction. We know that in recent years the idea of permanence has been rather strongly emphasized, and I do not want to be understood as discarding it without further and most thoughtful consideration. Perhaps so far as farm building is concerned we should qualify the term "permanence"; perhaps it should mean that type of construction which can be expected to exist without major repair or maintenance until obsolescence has driven the present structure into the discard and made the construction of an entirely new one justifiable from the standpoint of efficiency in operation and investment.

Probably all of us have seen examples of what I have had in mind. A power plant is erected of the most advanced design and equipped with the most efficient machinery available. In a few years new inventions, new designs, have so changed things that this power plant and its equipment have to be discarded because of inefficiency. The same thing is true of farm buildings. There are today barns built of so-called permanent materials which are so permanent that they can not be economically rebuilt to take advantage



"Now, how shall the agricultural engineer best serve in this present opportunity for promoting better farm buildings? I am firmly of the opinion that it is the agricultural engineer who should be depended upon to lead the new advance, to interpret the new expressions, and to effect the establishment of the great improvements in farm buildings which the years in the immediate future will logically bring. The agricultural engineer must convince himself of his destiny in this respect. He must furnish the inspiration whereby our agricultural population may be made to see the benefits which these improvements will bring. He must be aggressively ready to advise, and he must be able to advise with wisdom and intelligence."

of new and improved methods and practices in livestock management.

Therefore, I say that we should give careful consideration to this quality of permanence as possessed by the various building materials which we have available. There is no justification in putting up a long-lived masonry structure, if we have to destroy it with dynamite within a few years. In American agriculture there is no value in such ruins.

From still another viewpoint which we should take, let us consider the matter of *equipment*. Think for a moment what has come to American homes in the way of equipment in the last twenty-five years. I need not elaborate upon this subject at all because it has been emphasized so strongly that all of you are more or less familiar with it. Even so, how far should we go in recommending the use of this equipment? Again the question of obsolescence enters. To what extent is the farmer justified in making expenditures for expensive equipment when the development of newer, even greatly more efficient equipment is just around the corner? I do not want to have you think that I am advocating makeshift improvements, but I am just suggesting that we should use both discretion and wisdom in attempting to solve these problems.

New and Broader Vision Needed

Still another viewpoint to take, and it is a tremendously important one, is that regarding the present tendency toward *social development* in rural areas. Certainly social development must come; and the development of rural homes should be considered also in the light of whatever solutions are found for our rural social problems. This points inevitably to the fact that whoever promotes the construction of better farm buildings must also know something about rural social development. I appeal to you as agricultural engineers to study this phase of the matter, not only for the value this additional knowledge has in making better technicians of you, but for the deep and thrilling satisfaction you will find in being able to aid in making rural people happier, better citizens.

The whole matter of farm buildings needs reorganization and reestablishment. We have fallen into the deplorable habit of taking farm buildings as an incidental matter of fact. We do not see their exceedingly important, even fundamental, relationship to every other phase of agriculture.

How can such a reorganization and reestablishment be effected? In suggesting the answer to this question, I realize that I must necessarily imply some criticism of agencies already at work and doing an excellent service; but even so, I believe that some degree of criticism is fair, and even deserved.

Both federal and private agencies have been negligent and dilatory in advancing the cause of farm buildings. Many of you will recall the survey made several years ago, under federal supervision, of the research that was being made and that should be made in this field. One of our own ASAE members, Professor Henry Giese, spent time and effort in this survey and presented an excellent, thorough report, including specific recommendations for future procedure.

So far as we can see now, the time and effort so spent, as well as the great amount of time, effort, and money spent in the preliminaries to this survey, have been largely wasted. Nothing substantial has resulted.

As I see the matter now, we must have these things:

1. The arousal of a great, strong, and vocal interest, upon the part of agriculture, in better buildings, their design, their financing, their construction.
2. Establishment of a more positive and aggressive policy of farm building improvement on the part of our federal leadership in agriculture, and the concentration of a greater effort in this direction.
3. A better organized and a more systematic distribution of farm building improvement activities through state and county agencies.
4. A deeper appreciation on the part of private agencies and manufacturers of building materials of the opportunity which exists for the legitimate development of great markets in the rural field.

If we can effect the accomplishment of these four major purposes, then the cause of better farm buildings will have been tremendously advanced.

The Agricultural Engineer's Opportunity

Now, how shall the agricultural engineer best serve in this present opportunity for promoting better farm buildings? I am firmly of the opinion that it is the agricultural engineer who should be depended upon to lead the new advance, to interpret the new expressions, and to effect the establishment of the great improvements in farm buildings which the years in the immediate future will logically bring. The agricultural engineer must convince himself of his destiny in this respect. He must furnish the inspiration whereby our agricultural population may be made to see the benefits which these improvements will bring. He must be aggressively ready to advise, and he must be able to advise with wisdom and intelligence.

I have a deep and unbreakable faith in the future of American agriculture. I can envision logical advances which it will make, which will be comparable to the marvelous advances which American industry has made. The improvement of farm buildings is an essential factor in agricultural advancement. Certainly the agricultural engineer will have ample opportunity to exercise the most profound wisdom and the highest degree of intelligence which he can develop, and I most earnestly hope that he will see his opportunity and take advantage of it.

Preparation of Feeds for Cattle as It Affects Digestibility and Absorption

(Continued from page 259)

remained in the rumen. All the determinations were based on the dry weight of the material as the only practical basis possible.

"The data are too meager to warrant definite conclusions, but certain pertinent points are indicated. The more soluble nutrients, as represented by the crude protein, apparently pass out of the rumen more quickly than does the crude fiber. Since it was impractical to obtain date on the entire amount of material in the rumen at the time of sampling, the rates indicated are necessarily relative. The data already presented show that the finer material passes out of the rumen while the coarser material remains. It is obvious from the chemical determinations of the material remaining that the finer material, which passed on, contained less crude fiber in proportion to the crude protein than that being retained in the rumen."

The results we have obtained to date on this most important project have been encouraging. Its magnitude, however, permits only a brief presentation at the present time. We are now making rapid progress in the work with the hope that a more complete and extensive report will be available in the near future.

Characteristics of the Resistance Type Soil Sterilizer

By J. R. Tavernetti[1]

THE STERILIZATION of soil by heat generated in passing an electric current through it has been successfully accomplished, and, because of certain advantages, may be a desirable method. Fig. 1 shows the various types of present-day equipment making use of this principle. For sterilizing soil in flats, the equipment consists of sheet-metal electrodes mounted at equal intervals on the under side of a frame with alternate electrodes connected to the same electric terminal. The length and depth of the electrodes are the same as those of the flat in which the soil is to be sterilized. The electrodes are forced into the soil, and the entire flat is sterilized at one time.

For sterilizing soil in benches, sheet-metal electrodes whose length and width are the same as the width and depth of the bench, are placed in the soil at equal intervals with alternate electrodes having the same polarity. The number of electrodes used is governed by their size and by the capacity of the electric line.

The box sterilizer consists of a container with a hinged top and bottom in which sheet-metal electrodes are mounted at equal intervals.

The data that follow were obtained from experiments conducted to determine the operating characteristics of this type of sterilizer under different conditions of soil and equipment. Series of tests were made to determine the following points:

1 The general operating characteristics
2 The effect of varying the distance between electrodes
3 The effect of varying the soil density
4 The effect of varying the soil moisture content
5 The effect of the addition of an electrolyte
6 The effect of varying the voltage
7 The effect of various soil types.

Equipment and Method of Conducting Experiments. The experimental sterilizer (Fig. 2) consisted of a base of 1-in lumber and two sides of 2-in lumber. In each of these parts, grooves spaced 2-in apart were cut to hold the electrodes. The height of the electrodes was 7 in above the base, while the length could be varied from 0 to 18 in as desired. The distance between the electrodes could be varied in 2-in steps from 2 to 18 in. When the sterilizer was filled with soil, a 1-in piece of rock cork insulation was placed over the top and a piece of 2-in corkboard against the outer side of the electrodes.

The soil used in the experiments, except those on the effect of the type of soil, was a fine sandy loam relatively free of organic material. It had a dry weight of about 85 lb per cubic foot and a field capacity of about 18 per cent moisture.

Table 1 shows the data for each run. Soil temperatures were obtained by three chemical thermometers placed, respectively, in the bottom inch, in the center, and in the top inch. In some runs the temperatures at these three points increased at approximately the same rate while in the other runs the temperature at these three points varied widely (Run 22-c, Table 1). These differences, in temperature resulted primarily from differences in density. In all calculations the soil temperature was taken as the average of the temperatures at the three points.

[1]Associate in agricultural engineering, University of California. Assoc. Mem. ASAE.

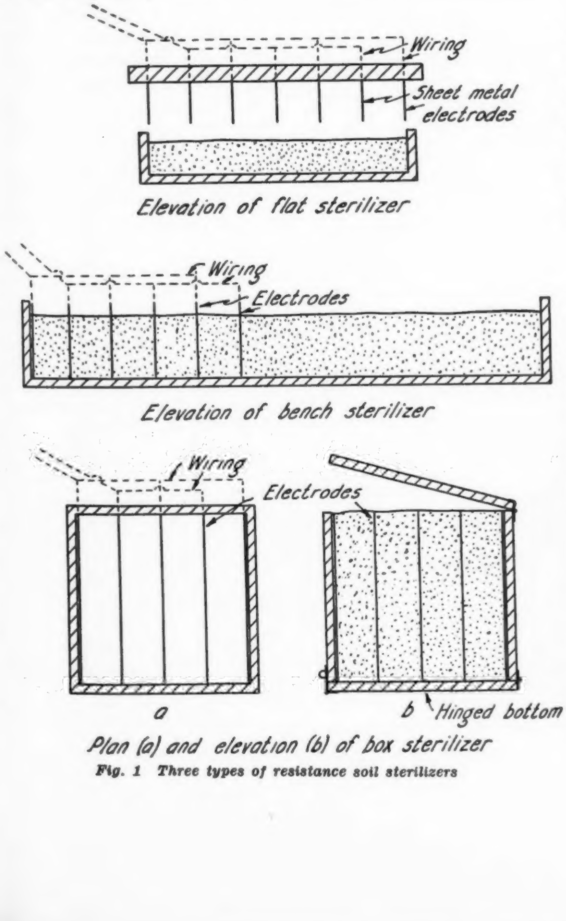


Fig. 1 Three types of resistance soil sterilizers

OPERATING CHARACTERISTICS

Fig. 3 shows the temperature and current curves for two different runs. These curves are characteristics of the

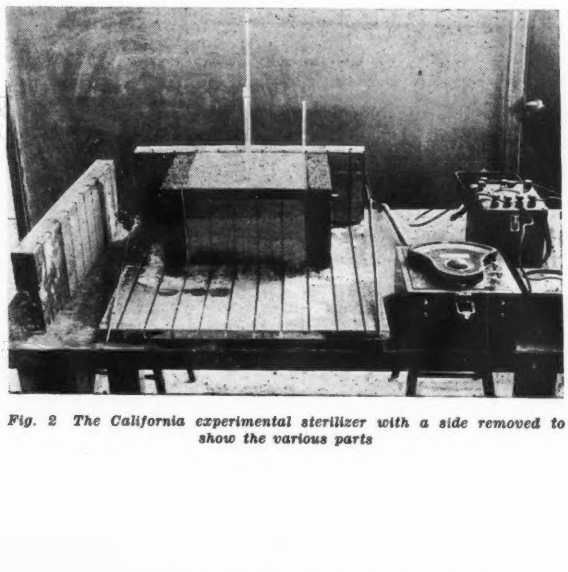


Fig. 2 The California experimental sterilizer with a side removed to show the various parts

TABLE 1. DATA OBTAINED FOR TWO RUNS SHOWING THE HEATING TIME, CURRENT, ENERGY, AND TEMPERATURES IN DIFFERENT PARTS OF THE SOIL

Run No. 18-d	Voltage, 240
Fine sandy loam	Density, 102 lb per cu ft
Dimensions of electrodes, 6x6 in	Distance between electrodes, 4 in
Moisture before heating, 18.4%	Moisture after heating, 11.5%

Minutes	Amperes	Watthours	Temp. at bottom, deg F	Temp. at center, deg F	Temp. at top, deg F
0	0.97	0	43	41	42
3	1.27	13	62	56	58
6	1.67	30	83	77	80
9	2.27	53	109	105	108
12	3.06	84	140	140	140
14	3.81	110	168	173	168
16	4.80	145	207	212	203
16:30	4.95	156	212	212	212
18	4.67	182	212	212	212
20	4.14	217	212	212	212
22	2.70	246	212	212	212
24	0.50	255	212	212	212

Run No. 22-c	Voltage, 242
Fine sandy loam	Density, 96 lb per cu ft
Dimensions of electrodes, 6x6 in	Distance between electrodes, 4 in
Moisture before heating 21.2%	Moisture after heating, 12.2%

Minutes	Amperes	Watthours	Temp. at bottom, deg F	Temp. at center, deg F	Temp. at top, deg F
0	1.22	0	46	45	45
3	1.73	17	70	70	60
5	2.23	33	89	92	73
7	2.92	53	111	121	89
9	3.77	78	140	159	110
11	5.10	111	176	206	135
13	5.75	155	212	212	195
14	5.79	174	212	212	212
15.5	5.50	210	212	212	212
17	4.90	240	212	212	212
19	0.50	255	212	212	212

runs made in all the experiments, although the values varied according to conditions. The maximum soil temperature obtainable with this method of heating was 212 deg F. When the temperature reached this point the moisture was converted to steam, and as the soil dried the heating automatically decreased. The current increased with

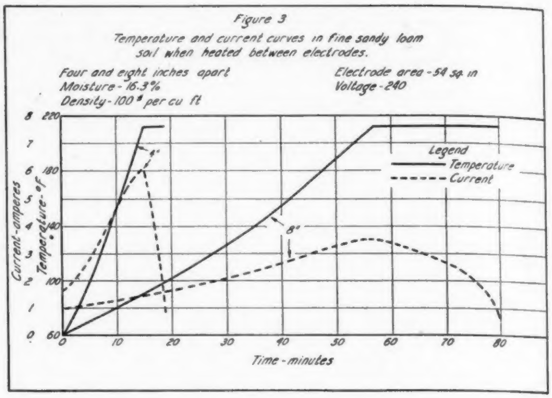


Figure 3
Temperature and current curves in fine sandy loam soil when heated between electrodes.

the temperature and was a maximum when the soil temperature reached 212 deg F, where it was about four times as great as at 50 deg. The moisture content of the soil after the heating stopped varied from nine to fifteen per cent, depending upon the initial moisure content. The total resistance between the electrodes consisted of two resistances in series: (1) the soil itself, and (2) the contact between the soil and the electrodes. For a given soil condition both decreased as the temperature increased, and the ratio between them remained approximately constant until the temperature reached 212 deg. At this temperature, the soil in contact with the electrodes dried more rapidly than in the main body, and the resistance of the contact became so great that practically no current flowed even though the main body of soil still contained considerable moisture.

Fig. 4 shows heating time and current with various distances between the electrodes. The current decreased with increased distances, but not in direct proportion, the contact resistance being a greater portion of the total resistance at the lesser distances. The time required to heat to a given temperature varied approximately as the square of the distance. The energy required to heat the soil from 60 to 212 deg F varied from 1.66 kwh per 100 lb with 2 in between electrodes to 2.05 kwh with 10 in between electrodes.

Fig. 5 shows heating time and current demand for soil with various densities. The time required to heat the soil to a given temperature varied inversely as the density,

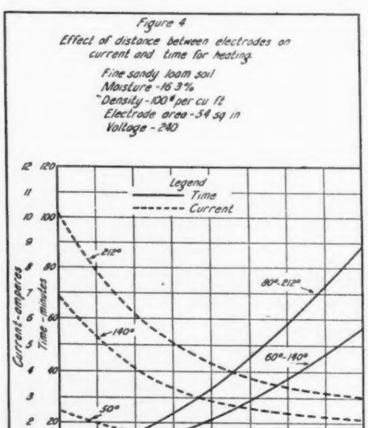


Figure 4
Effect of distance between electrodes on current and time for heating.

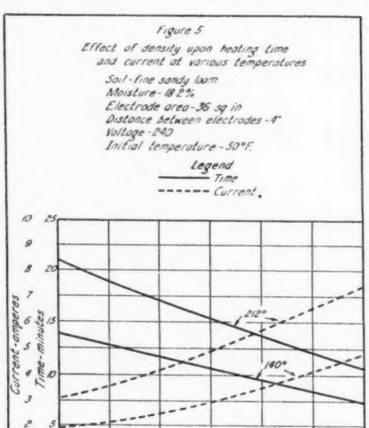


Figure 5
Effect of density upon heating time and current at various temperatures

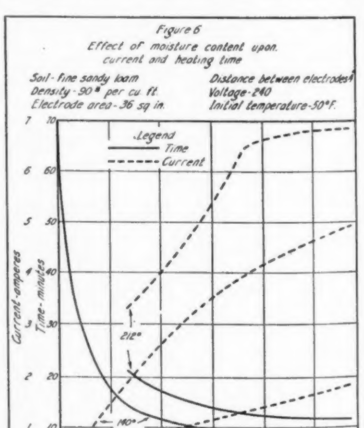


Figure 6
Effect of moisture content upon current and heating time

while the current varied directly with the density. The energy required to heat the soil from 50 to 212 deg F varied from 1.69 kwh per 100 lb with a density of 120 lb per cu ft to 1.80 kwh with 90 lb per cu ft.

Fig. 6 shows heating time and current demand for soil under various moisture conditions. With 10.0 per cent moisture, it was impossible to increase the temperature above 140 deg F, because the more rapid heating and drying of the soil in contact with the electrodes decreased the current so that the heat loss was greater than the heat input. The time required for heating was only about one-fifth as great with 14.0 per cent moisture as with 10.0 per cent. This decrease in heating time continued, but less rapidly, as the moisture content was increased. The current increased and the resistance decreased as the moisture was increased. At 213 deg F the current with 27.5 per cent moisture was only slightly greater than with 21.1 per cent, for two reasons: first, with a high moisture content and high temperatures, the soil expanded and bulged up, causing an increase in the contact resistance; second, the holding capacity of the soil was exceeded to such an extent that when heated the moisture drained out, decreasing the quantity of water and electrolytes in the soil.

Figure 7
Effect of the addition of an electrolyte (NaCl) upon the time required to heat soil from 50° to 212°F and upon the current flowing at 50°, 140° and 212°F
Moisture - 18.5% Area of electrodes - 36 sq in
Density - 110# per cu ft Voltage - 240
Space between electrodes - 12"

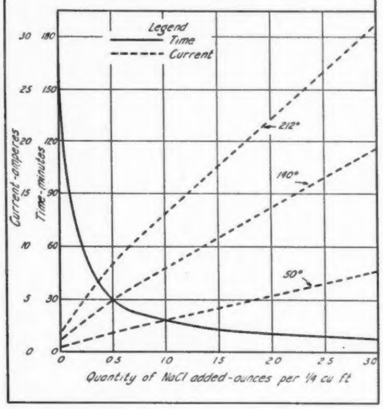
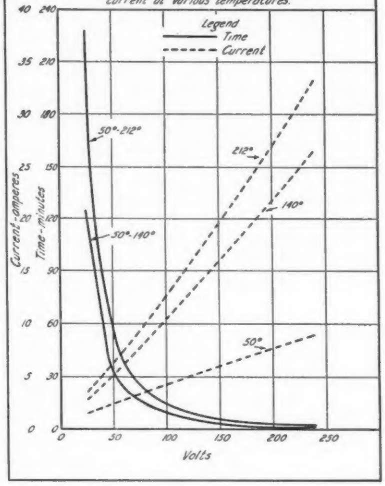


Figure 8
Effect of voltage upon heating time and current at various temperatures.



The energy required for heating from 50 to 212 deg F varied from 2.20 to 3.39 kwh per 100 lb of dry soil with 14.0 and 27.5 per cent moisture respectively.

Fig. 7 shows the effect upon heating time and current when an electrolyte was added to the soil. The heating time with tap water was about 6½, 13, and 23 times greater than when the soil was wetted with the 1, 2½, and 5 per cent NaCl solutions, respectively. The current increased directly with the quantity of electrolyte added.

Fig. 8 shows the effect of voltages upon heating time and current. The heating time varied inversely as the square of the voltage, and the current directly with the voltage.

Effect of the Type of Soil. In this experiment four runs were made with each of the four different types of soil. In two of the runs the soils were wetted with tap water to two different moisture contents, while in the other two runs the soils were wetted to the same moisture content with a solution that added 20 oz of ammonium sulphate to each cubic foot.

The soils used were a coarse sand weighing about 100 lb per cu ft and having a field capacity of about 6 per cent moisture, a fine sand weighing about 95 lb per cu ft and having a field capacity of about 8 per cent moisture, a fine sandy loam weighing about 85 lb per cu ft and having a field capacity of about 18 per cent moisture, and a clay loam weighing about 75 lb per cu ft and having a field capacity of about 28 per cent moisture.

For the runs with tap water, the electrodes were 4 in apart; for the runs with the electrolyte added, 12 in apart. In all the runs the same density calculated on a dry-weight basis was used.

The results obtained are shown in Tables 2 and 3. With the clay loam soil containing 19.2 per cent moisture it was impossible to heat above 140 deg F because of the drying of the soil in contact with the electrodes and the cutting off of the current.

When wetted with tap water, the various soils differed widely in heating time, current and resistance. Their order with respect to the least current and greatest heating time

TABLE 2. EFFECT OF TYPE OF SOIL UPON HEATING TIME AND CURRENT AT VARIOUS TEMPERATURES WHEN NO ELECTROLYTE WAS ADDED

Electrode area, 36 sq in
Distance between electrodes, 4 in
Voltage, 240

Type of soil	Coarse sand		Fine sand		Fine sandy loam		Clay loam	
Per cent moisture	13.1	18.9	14.5	23.2	17.6	26.5	19.5	33.7
Soil temperature, deg F								
50 deg Heating time, min	0	0	0	0	0	0	0	0
Current, amp	1.0	1.6	0.2	0.70	1.0	2.0	1.3	4.4
100 deg Heating time, min	7.5	6.2	31.0	13.0	7.7	5.0	5.0	2.8
Current, amp	1.8	2.9	0.4	1.05	1.8	3.4	3.8	7.8
140 deg Heating time, min	12.6	9.1	54.0	21.0	11.5	7.7	7.2	4.3
Current, amp	2.1	3.5	0.5	1.25	2.8	4.4	5.1	10.3
180 deg Heating time, min	17.3	12.5	76.0	30.0	14.5	9.9		5.3
Current, amp	2.2	3.0	0.6	1.20	3.8	5.0		12.1
212 deg Heating time, min	20.6	15.7	91.0	38.0	16.5	11.5		6.1
Current, amp	2.2	2.0	0.7	0.9	4.7	5.1		12.6

TABLE 3. EFFECT OF TYPE OF SOIL UPON HEATING TIME AND CURRENT AT VARIOUS TEMPERATURES WHEN AN ELECTROLYTE [20 oz of $(NH_4)_2SO_4$ per Cu Ft] WAS ADDED

Electrode area, 36 sq in
Distance between electrodes, 12 in
Voltage, 240

Type of soil		Coarse sand		Fine sand		Fine sandy loam		Clay loam	
Per cent moisture		13.2	19.0	14.9	24.1	17.5	27.2	19.2	34.8
Soil temperature, deg F									
50 deg	Heating time, min	0	0	0	0	0	0	0	0
	Current, amp	9.7	13.3	10.2	14.1	3.6	8.5	0.3	8.5
100 deg	Heating time, min	2.4	1.6	2.1	1.9	6.5	3.5	16.0	3.9
	Current, amp	15.7	20.8	16.5	20.4	6.0	14.6	2.8	15.3
140 deg	Heating time, min	4.1	2.9	3.5	3.0	10.3	5.6	28.5	0.1
	Current, amp	20.4	25.3	22.3	23.4	8.2	19.4	3.5	19.3
180 deg	Heating time, min	5.4	4.1	4.4	4.3	13.1	7.1		8.0
	Current, amp	20.8	27.9	25.7	24.7	10.4	22.6		21.7
212 deg	Heating time, min	6.1	5.1	5.6	5.5	15.5	8.5		9.3
	Current, amp	20.8	23.2	26.7	24.9	12.3	23.7		22.4

and resistance was fine sand, coarse sand, fine sandy loam, and clay loam.

When wetted with a solution of ammonium sulphate, the various soils with the higher moisture contents showed little difference in heating time, resistance and current. With the lower moisture contents the differences were greater. The order of the soils with respect to greatest resistance, greatest heating time, and least current was reversed from that when tap water was used, being clay loam, fine sandy loam, coarse sand, and fine sand. With all the soils an increase in moisture content decreased the heating time and resistance and increased the current.

The results obtained indicated that the quantity of electrolytes and moisture in the soil, rather than the type, determined the operating characteristics. The only effect of the soil type was on the moisture content necessary. To obtain the same characteristics when all the other conditions were the same, soils having a high moisture-holding capacity required a greater moisture content than soils having a lower moisture-holding capacity.

CONCLUSIONS

The resistance-type soil sterilizer has the advantages of simple and inexpensive equipment, easy and speedy operation, uniform heating, and semi-automatic operation. It has, however, two serious disadvantages—hazard from an electrical shock and variable electrical load.

Since 220 volts is commonly used in these sterilizers, contact with electrodes, the soil, or wet portions of the equipment is dangerous. The box and flat sterilizers can be fairly well enclosed and equipped with safety switches, but it is difficult to prevent the equipment from becoming damp or wet.

The bench sterilizer is extremely hazardous because it cannot be enclosed and because the entire bench is charged even though only a small portion is being sterilized. The use of low voltage will assist in reducing the hazard, but may require the addition of an electrolyte to the soil in order to increase the current and reduce the heating time. In adding an electrolyte care must be taken not to obtain a concentration that will be toxic to plants.

The electrical demand of the sterilizer varies widely, depending mainly upon the electrolytes in the soil. It is also affected by distance between the electrodes, soil density, and moisture content. With one soil, the current may exceed the capacity of the electric line; with another, the current may be so low that the heating time will be excessive. Any control by varying the electrodes is difficult, because in making the sterilizer the electrodes are fixed and cannot easily be changed. Controlling the current by varying the density and moisture content is not satisfactory, for it is advisable to use a relatively high density and moisture content in order to obtain more uniformity of heating and in order to reduce the resistance of the contact between the electrodes and the soil. The best method of control over the electrical demand would be the use of different voltages. With this method the voltage could be easily reduced when the current neared the maximum permissible.

A Plan to Provide Adequate Water Storage

DESPITE the fact that farmers in some sections find their water storage ponds or earth tanks inadequate to provide a supply for an extended period of dry weather, many hesitate to clean out or deepen the reservoirs for fear of wasting the water. Besides, it is more or less difficult to do the work when the stored water is several feet deep.

However, agricultural engineers have worked out a plan whereby no water need be wasted, cleaning out or deepening is made easy, and at the same time additional storage facilities may be provided.

This plan, briefly, consists of making an auxiliary tank or pond. This should be located near the existing reservoir and, of course, should be deeper. Water in the old tank or pond can then be drained into the new one. The old reservoir is now ready to be deepened or cleaned out.

The job can be done quickly, easily, and, frequently, at a saving of money by the use of dynamite. Shallow ponds, those up to three and a half feet deep or even deeper, and of widths up to forty feet, can be blasted by the cross-section method. The post-hole method of blasting will provide a pond up to thirty-six feet wide and with a maximum depth of twelve feet. Similarly, reservoirs can be cleaned out.

Determining Colloids in Soil for Rammed Earth Construction

By Ralph L. Patty[1]

COLLOIDS in soil are unfavorable for pise or rammed earth construction. In fact, a bare pise wall will resist weathering in almost a perfect inverse ratio to the colloidal content of the soil from which it is made.

A study of rammed earth construction has been under way at the South Dakota State College since January 1, 1930. After some work with small test pieces for determining the optimum moisture content in soils for this type of construction, the building of small weathering walls was begun. These walls were made of the typical soils of various parts of the state. In all, 29 different soils were built into these weathering walls. The walls were 3 ft long by 30 in high and 12 in thick. They were built on a good concrete foundation and roofed with small flat-topped covers with an eave or overhang of only 2½ in.

The reason for the small overhang was to reduce to a minimum the protection from weathering on the side walls. On the other hand, it was found very necessary to protect the tops of the walls from rain and to prevent the flowing of water down the face of the walls. The walls were built with an east and west axis, providing a north and south exposure to their broad sides and of course no protective covering was used. The yard in which the walls are built is securely fenced.

During the summer of 1930, 24 of the 29 walls were completed, and the others were built the following spring. Most of these walls have, therefor, had an exposure of five years. This entire period has been necessary for drawing conclusions on many of them. Only two or three of the walls showed definitely within the first year that they were unfavorable. It has been only during the past winter and spring that they could confidently be classified.

About a year ago a study was begun to determine the colloidal content of the soils used, and the relationship of the colloids to weather resistance of the walls. The hydrometer method of Bouyoucos was used for making these analyses and a determination was made of the total sand, the total colloids, the total conventional clay, the very fine clay, and the total silt. The colloids were of particular interest in this study, and with this method of analysis both the organic and metallic colloids are of course included.

The hydrometer method of analysis lends itself very satisfactorily to work with rammed earth. The results are quite accurate enough for all soils tested, and it is easily possible to make the complete analysis of two soils in a day along with other work if care is used in preparing the soil samples for the following test while the one is being run. Not less than two tests were made of each soil for a check and in most cases three were made.

After the tests were made, the summary sheet showed a definite relationship between the colloidal content of the soil and the quality of the wall made from it. The walls were then carefully classified as to quality after standing four to five years without protective coverings. Although the weathering walls had been given a careful inspection twice yearly, they had been rated only in a general way as poor, fair, good, and excellent. They were now given a per cent rating so that a curve ratio could be obtained. In rating the walls as they have resisted weathering, the poorest was given a mark of 50 per cent, and a perfect soil would rate 100 per cent. Two persons rated the walls at a different time and the average of the two ratings was used. The walls were rated without a record of the analysis of the soil from which it was made.

The results of the study to date would indicate that walls rating 90 per cent or above would be excellent in pise work and that walls rating 85 to 90 per cent would be quite satisfactory. Walls rating from 80 to 85 per cent would probably be satisfactory, especially if they were given a protective covering. Most of those rating from 80 to 85 per cent are walls that stood up well for the first two or three years and did not check badly when drying out. The walls rating below 80 per cent have not only been unsatisfactory in resisting weather as a bare wall, but to date it seems quite possible that protective coverings commonly used on other walls will be unsatisfactory for them. It should be borne in mind that these are not soils especially selected for rammed earth work. They are taken as they come, the bad with the good. Also, a few of them with a low rating to date seem to be satisfactory in walls when sand is added. The addition of sand will not correct all of them, however. In no case has the addition of sand

TABLE 1. ANALYSES OF SOILS IN WEATHERING WALLS —HYDROMETER METHOD

Wall No.	Ratings, per cent	Total colloids	Conventional clay	Very fine clay	Conventional silt	Total sand	Remarks
22	93.5	16.8	17.0	16.0	7.8	75.2	Fine sand
10	99.0	17.0	14.3	14.2	9.5	76.2	
5	99.0	19.0	15.9	13.9	6.9	77.2	Graduated sand
20	97.5	20.4	19.2	18.2	9.2	71.6	
61	87.5	30.0	23.4	19.7	28.6	48.0	Probably underrated
46	95.5	31.3	21.6	17.7	33.6	44.8	
57	90.5	32.3	22.8	18.7	49.2	28.0	
9	95.5	32.5	27.0	19.1	19.7	53.3	
41	97.0	33.0	23.8	18.2	56.3	19.9	Very low in sand
28	88.5	34.1	25.1	20.2	27.0	47.9	
35	88.0	34.1	26.9	23.5	25.4	47.7	
18	90.0	34.4	28.4	24.4	36.0	35.6	
39	89.0	35.6	27.6	20.0	45.2	27.2	
55	86.0	35.8	28.0	23.6	30.2	41.8	
7	91.5	36.3	26.0	21.4	46.1	27.9	
53	92.0	37.0	26.4	23.3	44.8	28.8	
81	89.5	37.3	29.6	24.2	24.6	45.8	No. 2 soil
16	90.0	38.1	28.8	23.6	54.2	17.0	
48	82.5	38.1	26.9	23.3	50.9	21.7	
3	79.0	40.4	33.2	30.0	48.2	18.6	
11	82.5	40.9	33.1	28.1	32.6	34.3	
37	73.5	41.0	34.2	30.7	27.4	28.4	
51	69.0	42.2	33.0	30.2	37.2	29.8	
26	72.5	43.5	35.0	30.4	39.8	25.2	
78	75.0	44.6	33.1	29.1	31.9	35.0	Does not crack open
63	65.0	46.8	38.4	34.1	38.6	23.0	
24	75.0	53.0	41.4	36.2	39.3	19.3	Does not crack open
14	50.0	55.2	49.1	38.0	25.0	25.9	
29	50.0	61.0	51.5	46.0	28.7	19.8	

[1]Extension specialist, and chairman, agricultural engineering department, South Dakota State College. Mem. ASAE.

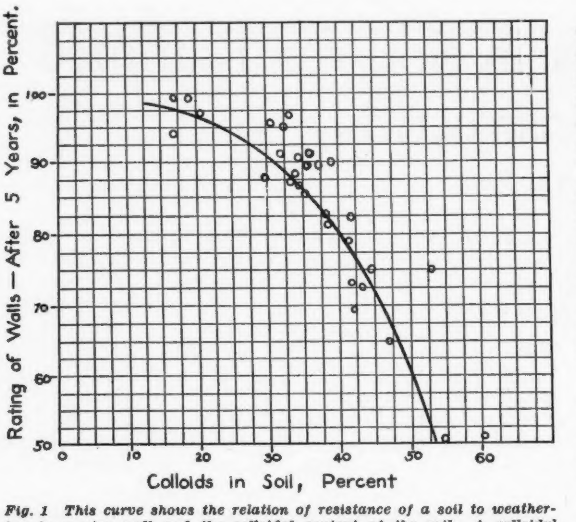


Fig. 1 This curve shows the relation of resistance of a soil to weathering in a pise wall and the colloidal content of the soil. A colloidal content of 40 per cent is the distinct dividing line between a favorable and unfavorable soil

improved the wall if the original soil contained more than 42 per cent colloids.

The dividing line between favorable and unfavorable soils for pise work seems to be just at the point where the soil contains 40 per cent colloids. If the total colloids in the soil run 40 per cent, the soil is doubtful, and if it goes above this point, the soil is unquestionably unfavorable. It is quite certain this dividing line will not range more than one per cent either above or below forty. Since this study includes 29 quite different soils from far distant localities and since no exception has been found, the above conclusions seem definite and entirely reliable. It should therefore be, and we believe is, entirely possible in thirty minutes time to determine whether or not a soil is favorable for pise work (the total colloids can be determined in 30 min) by making the test for colloids. Not only that, but the quality may be determined and after more years of the test it will be possible to accurately forecast the number of years the soil will stand in a bare wall under average climatic conditions.

Table 1 shows the five-year-old walls listed in the order of their rating or quality as they stand today, and with the percentage of total colloids found in the soil from which the walls are made shown in the third column. The complete analyses are also included. Fig. 1 shows the curve of relationship between the soil colloids and the quality of the walls that are made from them. In securing the soil for the walls only a part of the top soil was taken, possibly an average of one-fourth of the top 6 in of soil. This seems to be of little importance in residual soils so far as pise work is concerned. Neither does the inclusion of reasonable amounts of grass or root fiber affect the wall, except to increase its strength[2], and decrease the smoothness of the wall surface.

Method of Determining Colloids in Soil. The Bouyoucos method of soil analysis, also known as the hydrometer method, is comparatively new. It was developed by Professor G. J. Bouyoucos of the Michigan State College, and the test is made with special equipment designed by him. This equipment consists of a soil disperser or agitator, a special cylindrical jar or graduate of definite capacity and depth, a hydrometer of special weight and design, an ordinary Fahrenheit thermometer, a stop watch, and deflocculating agents (Fig. 2). A 50-gm sample of oven-dry soil is taken (except for very sandy soils) and put to soak in distilled water in the agitator cup for at least 10 min. The cup is then filled with distilled water to a point within 1½ in from the top and the deflocuating agents added. Professor Bouyoucos recommends 5 cu cm of sodium hydroxide and 5 cu cm of sodium oxalate for the deflocculating agents. The electric agitator is then started and the ordinary soil is stirred for 10 min. The contents of the cup is then turned and rinsed into the large glass graduate, and distilled water added until the graduate is filled to a mark indicating 1,000 cu cm of the mixture plus the submerged hydrometer.

The hydrometer is then removed and the contents of the graduate inverted several times and thoroughly agitated. As it is set down, the stop watch is started and readings are taken at intervals of 40 sec, 15 min, 1 hr, and 2 hr. At the end of 40 sec the total sand has settled out. At the end of 15 min the hydrometer reading will give the total grams of soil still in suspension, and this reading over the weight of the soil sample taken in grams multiplied by 100 will give the total colloidal content of the soil in per cent. This result therefore can be obtained in less than 30 min from the time the agitator is started. At the end of one hour the total conventional clay will still be in suspension, and it may be obtained in the same way. At the end of two hours the very fine clay will still be in suspension, and the amount in per cent can be figured. The total sand is obtained by subtracting the total soil in suspension at the end of 40 sec, and the total silt is that portion of the sample that is left after subtracting the total sand and the total conventional clay. The total silt, then, is the portion of soil that settles in the interval between 40 sec and 1 hr.

Corrections must be made for the temperature of the water in this test at each reading. A temperature of 67 deg F is the basic temperature for which no correction of the hydrometer reading is made. For each degree of temperature above 67 deg F an addition of 0.2 of one unit is added to the hydrometer reading and for each degree below 67 deg F, a substraction of 0.2 of a unit is made. A few additional corrections and variations in the test are made for unusual soils, such as those that are difficult to disperse or very sandy soils. These have been carefully worked out in order to reduce a possible error to a minimum, and complete directions for making the analysis is furnished with the equipment.

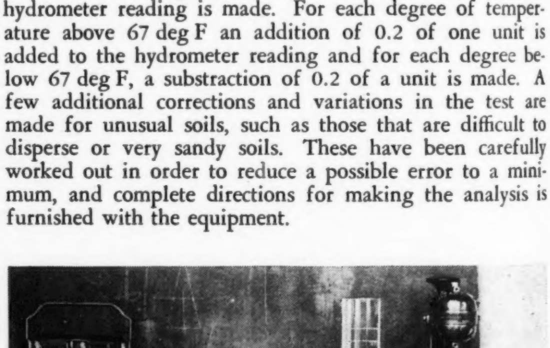


Fig. 2 Equipment used in determining colloids in soils for rammed earth. The equipment of particular interest is the tall graduate just to the right of the scales, the hydrometer of special design in the foreground and just in front of the right-hand scale pan, and the electric soil disperser and cup at the right. The disperser is a rebuilt drink mixer.

[2]South Dakota Agricultural Experiment Station Bulletin No. 277, "Rammed Earth for Farm Building Walls."

Agricultural Engineering Digest

A review of current literature by R. W. TRULLINGER, senior agricultural engineer, Office of Experiment Stations, U. S. Department of Agriculture.

ELECTRIC HEAT FOR PROPAGATING AND GROWING PLANTS, *B. D. Moses* and *J. R. Tavernetti*. California Sta. Circ. 335 (1934), pp. 18, figs. 17. Practical information is presented for use both by engineers and laymen on the use of electricity for heating hotbeds and regarding the equipment. It is based on studies conducted by the station in cooperation with the California Committee on the Relation of Electricity to Agriculture.

TESTS OF THE FIRE RESISTANCE AND STRENGTH OF WALLS OF CONCRETE MASONRY UNITS, *C. A. Menzel*. [Chicago]: Portland Cement Assoc., 1934, pp. X + 215, figs. 89. This report presents the principal results obtained in a comprehensive and systematic investigation of the fire-resistant and load carrying properties of 215 walls of concrete masonry units when subjected to standard fire endurance and load tests. The tests covered studies of the relative influence of such factors as type and grading of aggregate, cement content, design of unit, type of mortar, workmanship, and application of plaster. Wells about 5.5 ft wide and 6 ft high with a total area of about 33 sq ft were employed instead of walls 9 ft in height and 100 sq ft in area required by the specifications. To compensate for the reduction in size of the test walls as well as to improve the precision with which such tests are usually conducted, a particularly rigid test technic was adopted.

It was found that the fire endurance period of concrete masonry walls constructed of units of a given design was independent of the type of mortar, depended to some extent on the character of the mortar joints, but depended mainly on the composition of the units as influenced by the type and grading of aggregate and the cement content. With a given type of concrete the fire endurance period of walls of the single-unit type (constructed with a single unit through the wall thickness) increased as an exponential function (exponent 1.66 to 2.03) of the average air-dry weight per square foot of wall assembly. This relationship appears to be fundamental and shows that the effectiveness of a given type of concrete in walls of the single-unit type can only be improved by increasing the weight of the concrete in the unit and not by distributing the given weight in a different design. However, with walls of the duplex and triplex types (constructed with two and three units through the wall thickness and separated by an air gap) or with walls of the single-unit type having the core spaces filled with different aggregate materials, the fire endurance period was increased at a substantially higher rate with weight increases than obtained with ordinary construction.

The application of a plaster finish to either the exposed face or both faces of the walls resulted in substantially higher fire endurance periods and wall strengths (after fire exposure) than were obtained with similar unplastered walls exposed for the same or shorter periods.

The compressive strength of concrete masonry walls tested either without exposure or after exposure to fire was directly proportional to the original compressive strength of the units. These linear relationships were obtained with walls laid up with units of a wide range in composition, design, and strength. The strength of walls tested without exposure to fire and constructed of units of a given design and strength was independent of the type of aggregate, depended to some extent on the type of mortar, but depended mainly on the type of mortar joints and character of mortar bedding. After exposure to fire the wall strength was influenced to a more marked degree by the type of aggregate than by the type of mortar but to an even greater extent by the type of mortar joints and character of mortar bedding. Closely similar strengths were obtained from walls laid up with units of a given strength with portland cement-lime mortars ranging from 1-1-6 to 1-0.15-3. When the cement content of the mortar was reduced below that of a 1-1-6 mix there resulted a decrease in wall strength which was approximately proportional to the decrease in the cement content of the mortar. These statements apply to walls exposed to fire as well as to unexposed walls.

No outstanding advantage in wall strength after fire exposure was discernible for one design of unit over another for walls of the same thickness laid up with units of different design but comparable as to the proportion of net area bedded and strength (gross area).

Five appendixes are included relating, among other things, to test procedure and temperature measurements.

WIND PRESSURES ON BUILDINGS, *A. Bailey*. Inst. Civ. Engin. [London], Elect. Engin. Papers, no. 139 (1933), pp. 29, pl. 1, figs. 27. Following a brief review of the work of others with small scale models, the results of comparative tests on a large shed in the natural wind and on a scale model of the shed in a wind tunnel are reported. The shed was 100 ft long by 42 ft wide and had a height of 33 ft at the ridge and 23 ft at the eaves, the angle of slope of the roof being 25.5 deg. It had a heavy steel and timber framework covered on the outside with corrugated iron with a felt-covered timber roof. At each end of the shed there were large sliding double doors 12 ft wide by 22 ft high.

The data obtained from the actual shed showed that the wind movement produces a substantial reduction of pressure on both the windward and the leeward slope of the roof, combined with an increase of pressure on the windward wall and a reduction of pressure on the leeward wall. No substantial difference was observed due to opening the doors, but this was to be expected since there is a gap about 4 in wide all around the edges so that the shed was never really closed. The maximum reduction of pressure is generally at the point immediately beyond the eaves on the windward slope, and the suction falls rapidly as the wind travels up the slope. It then begins to increase again when nearing the ridge and becomes almost constant on the leeward slope.

Three sets of tests were carried out on the model in the wind tunnel with angles of incidence of the air stream of 0, 20, and 40 deg, and with four wind speeds in each case, and an additional test was made at one speed with the air stream parallel to the ridge. The tests with an angle of incidence of 20 deg showed slightly greater suction at all points on the roof, with the exception of the first point on the windward side, at which point the suction was very slightly reduced. At 40 deg these effects were increased and the pressure on the windward wall was reduced. The test with the wind parallel to the ridge showed a moderate suction over the whole of the section examined, including both the vertical walls, which would be due to the eddy set up by impact of the wind on the end wall of the shed.

A comparison of the full scale and model tests showed that the general form of distribution of pressure over the roof is similar, the main differences being that in the full-scale tests the pressure on the windward wall is often less and the suction on the leeward slope is nearly always greater than that which would be predicted from the model tests.

A comparison of the tests with the wind incident at an angle of 20 deg shows much the same relation as at 0 deg, but the one set of full scale tests which were made with the wind at 40 deg gave a reduction of pressure on the leeward slope which was never greater than that obtained in the corresponding model tests. The tests appear to indicate that in the case of a large structure in the open air there is a factor which is not present when tests are carried out on small models with an artificial wind in a wind tunnel. Whether this factor is a scale effect or is due to wind structure is not yet clear.

The conclusion is drawn that a 50 per cent increase on the result obtained on a small model in a wind tunnel would be sufficiently near for all practical purposes. Whether the figure of 50 per cent would apply to any scale ratio or to any form of building still remains to be determined.

FARM AND MACHINE. Farm and Machine [Inst. Res. Agr. Engin., Univ. Oxford], 1 (1934), pp. 94, pls. 5. This publication comprises the report of the Institute for Research in Agricultural Engineering of the University of Oxford for the year ended September 1933 and miscellaneous papers based on research by the institute on tractor developments in 1933, stationary and portable engines for farm work, pneumatic tires for farm carts, haymaking and harvesting development, survey of mechanized farms, St. John's College Farm at Long Wittenham, the needs of the farmer and the responsibility of electricity supply undertakings, electric motors for farms, sulfuric acid spraying in 1933, and alternatives to mole draining.

A brief description of agricultural engineering research agencies throughout the world is included, together with an abridged tractor data sheet. *(Continued on page 284)*

NEWS

Impressions of ASAE Annual Meeting

By Walter B. Jones

SOIL CONSERVATION was the dominant theme at the 29th annual meeting of the American Society of Agricultural Engineers, held June 17 to 20 at the University of Georgia, at Athens. Not only did it well-nigh monopolize the separate sessions of the Land Reclamation Division (incidentally to be known hereafter as the "Soil and Water Conservation Division") and take a prominent place in the general program, but it interlocked sharply into one of the Power and Machinery Division sessions. Its ramifications, or at least its implications, could be traced into the subject matter of the College, Farm Structures, and Rural Electric Divisions.

This was no mere echoing of popular interest arising from government emphasis on erosion control projects and programs. It was wrestling with the actual working problems confronting engineers charged with getting jobs done, and critical deliberation on the wisdom of policies and practices in the light of rapidly transpiring experience. Contrasted with the academic, not to say anemic, interest in erosion control engineering during the long, plodding years that were laying the foundation, the warmth of interest, amounting almost to fervor, displayed at Athens was most striking to the veteran observer.

Headlining the conservation theme was the address at the June 19 general session by Dr. Hugh H. Bennett, chief, Soil Conservation Service, U. S. Department of Agriculture. It was given place, too, in the preceding day's general session by Assistant Secretary of Agriculture M. L. Wilson who, like Dr. Bennett, came down from Washington expressly to make known their objectives and their methods to the agricultural engineering profession. Most or all of the erosion control papers will appear in these pages next month, and those on other subjects in due course; hence, no attempt will be made now to go into the tenor of subject matter.

Although held in the heart of the Southeast, and in a spot probably as typical of its agriculture as could be chosen, the impression of remoteness from the agricultural center of things was largely illusory. In terms of actual travel from Chicago, assuming it to be the hub of the Middle West, the trip to Athens was comparable with those to Lincoln, Nebraska, or the twin cities of Minnesota. Certainly it was no barrier to attendance, which was better than 90 per cent, in terms of men registered, of that at Purdue and Columbus in 1932 and 1933, and higher than that at Detroit last year.

In richness of opportunity for exploration in timely agricultural engineering developments the meeting place was most apt; indeed, if there were any able to do full justice to all of these opportunities, they probably are not home yet. This observer was limited to the TVA inspections in the laboratories of the University of Tennessee at Knoxville, about the village of Norris, and at the site of Norris Dam. Again space forbids detail; suffice that with Geo. W. Kable and Lee C. Prickett as official hosts every reasonable opportunity that time permitted was given for gathering data and perspective visually and by question.

Similar open house, meanwhile, was being held at the outstanding erosion control project in the vicinity of Spartanburg, South Carolina, at the invitation of J. T. McAlister, chief agricultural engineer on that project. Following the meeting was a conducted tour from Athens via the Stone Mountain Confederate Memorial, the President's Hospital at Warm Springs, and other points of more technical interest to the federal soil tillage laboratory at Auburn, Alabama, not to mention the other attractions at this, the home of the state's polytechnic institute and scene of the researches by Professor M. L. Nichols and his associates.

Although Professor Nichols modestly remarked that the Southeast was terracing land when he was a baby, his work looms large among the many who have developed the technique and the enthusiasm whereby the region is having a veritable renaissance of terracing. A sample, or perhaps a symbol, of this is the SCS Sandy Creek project in the vicinity of Athens, to inspection of which the entire afternoon of June 18 was devoted in lieu of a general session, and which was a revelation to those from areas where terracing is less urgently needed and less accepted.

Closely akin to this large extension of terracing and the need it creates for engineering advice and supervision was the proposal made by Professor Nichols in a paper before the College Division calling for the creation of county agricultural engineers, to be in fact and perhaps in name technical assistants to the county agent whose other duties, mainly administrative, permit neither the time nor the specialization to carry on the needed amount of agricultural engineering service.

Among the myriad manifestations of southern hospitality was the true southern barbecue staged by the Athens Chamber of Commerce at the country club, where the registration badge was the token of admittance and a lusty appetite the essential qualification. Later the same evening (June 18) came square and round dances in the physical education building on the campus. Next evening occurred the annual dinner, also on the campus, marked by such distinctive delicacies as spring chicken in the southern manner, peanut ham, candied yams, corn sticks, and ice cream in a perfect optical illusion of a Georgia peach as to shape, tint, and foliage, and such firmness of freezing as must have extended southward to the Antarctic.

Guided amid his raillery by Toastmaster Wyatt Arnton Clegg came the presentation of the Cyrus Hall McCormick Gold Medal to Theo. Brown, and the award of the Farm Equipment Institute trophy to (embarrassingly enough) the Georgia student branch of the ASAE. "Observations Relevant and Irrelevant"—but always witty—were made by that juristic and post-prandial veteran, Judge A. W. Cozart of Columbus, Georgia.

Adjourning to an open-air amphitheatre on the campus, and in an atmosphere of crisp coolness that was almost a shock to natives of the corn belt, the guests saw and heard what may be called a musical morality play, "Heaven Bound," by the choir of the A. M. E. Church of Athens. The number of splendid voices, the innate sense of rhythm and harmony, the dramatic values in costuming, staging, and action, and the evidently sincere religious expression manifested are not for an engineer to describe.

Of the special features arranged for the gentler and younger relatives of the engineers, this observer can only reflect random remarks to the effect that in this, as in other respects, Local Chairman Driftmier and his cohorts had done a splendid job. The increase in the "auxiliary" attendance registered indicates that the trend is continuing to make the annual meeting a family party.

If the other branches of agricultural engineering were a bit eclipsed by the Land Reclamation Division taking its long-awaited place in the sun, there was no gloom in the shadow nor slackening of pace. As usual, the rural electric sessions were largely and closely attended, with full schedules of timely, well-rounded subject matter. From the independent utility as well as TVA angles, regional developments and conditions were featured along with research and statistical information of national scope.

Research in cotton ginning, and related matters, usually the special prerogative of the Southern Section, gave regional emphasis to the work of the Power and Machinery Division. The southern influence was discernible in the agenda of the Farm Structures Division, though the more striking emphasis was devotion of an entire session to fencing.

Conceding the argument of those who say there is no need to attend meetings to hear papers that can be read at leisure in these pages, and having disposed with brief mention of the accessory features, there remain those tremendous trifles—the unrecorded discussions of technical matters, the informal group conferences and casual contacts that crowd the seeming broad areas between sessions, the prevailing yet intangible atmosphere. In the year since the 1934 annual meeting at Detroit has come a marked change. While it could not be said there was discouragement a year ago, there was some of disturbed orientation, of conflicting viewpoints, of uncertainty as to the next move, a bit of the defensive attitude.

Now the question is not how to line up and get the parade started, but how to keep up with it. As one remark in the college program put it, the difficulty is not to find jobs for graduates, but to keep them in school until they graduate. Differences in opinion persist, but they are more of method and less of objective. Without its being said in so many words, there is an evident feeling that agricultural engineering as a profession is taking longer and more confident strides.

ASAE Officers for 1935-36

AS A RESULT of the annual election of officers of the American Society of Agricultural Engineers, completed just previous to the 29th annual meeting of the Society, the following new officers were elected: President, L. F. Livingston, manager, agricultural extension section, E. I. du Pont de Nemours and Company; First Vice-President, M. L. Nichols, professor and head of the agricultural engineering department, Alabama Polytechnic Institute; Second Vice-President, Geo. G. Kable, senior designing engineer, agricultural-industrial division, Tennessee Valley Authority; Councilor, Q. C. Ayres, associate professor of agricultural engineering, Iowa State College. The Secretary of the Society, Raymond Olney, was re-elected Treasurer.

The new Council of the Society for the year 1935-36 includes the above-named officers, together with E. E. Brackett, professor of agricultural engineering, University of Nebraska, and R. H. Driftmier, professor of agricultural engineering, University of Georgia, as Councilors; and Arthur Huntington, public relations engineer, Iowa Electric Light and Power Company, and G. W. McCuen, professor of agricultural engineering, Ohio State University, as Senior and Junior Past-Presidents, respectively.

The newly elected Nominating Committee consists of Leonard J. Fletcher (chairman), William Boss, and C. E. Seitz.

1936 ASAE Meeting

DURING the annual meeting of the American Society of Agricultural Engineers held last month, the Council of the Society voted to hold the 30th annual meeting at Estes Park, Colorado, during the week beginning June 21, 1936.

At the annual business session of the Society held following the decision of the Council, this action was heartily endorsed. Also the Society went on record at this session as favoring the holding of the 1938 meeting in California with the Pacific Coast Section of the Society as host.

Second International Congress of Rural Engineering

AT THE SECOND International Congress of Rural Engineering to be held at Madrid, Spain, September 26 to October 3 next, the American Society of Agricultural Engineers will be represented by two of its members, Professor G. W. McCuen, junior past-president of the Society, and professor and head of the agricultural engineering department, Ohio State University, and Dr. J. B. Davidson, first president of the Society, and professor and head of the agricultural engineering department, Iowa State College.

The following papers have been registered by the Society for presentation at the Congress, and these will be presented in person by Professor McCuen and Dr. Davidson.

1 "A Resume of the Uses of Rubber Tires on Farm Implements," by Prof. G. W. McCuen.

2 "Improvement of Farm Machines," by Dr. Davidson.

3 "Sterilization of the Soil by Electricity," by I. P. Blauser, secretary and field engineer, Ohio Committee on the Relation of Electricity to Agriculture.

4 "Development of the General-Purpose Type Tractor and its Adaptation to Agriculture," by Arnold P. Yerkes, International Harvester Company.

5 "Diesel Tractor Development in the United States," by Leonard J. Fletcher, agricultural engineer, Caterpillar Tractor Company.

Canadian Section Presents Program

THE Canadian Section of the American Society of Agricultural Engineers, which functions also as the agricultural engineering group of the Canadian Society of Technical Agriculturalists, presented a program in connection with the 15th annual convention of the latter organization, which was held at the University of Alberta, Edmonton, the last week in June. This program was confined to one half-day session, at which was featured a paper on the Diesel-engined tractor presented by E. A. Hardy, professor of agricultural engineering, University of Saskatchewan, and a review of agricultural engineering projects in Canada by J. M. Armstrong of the Central Experimental Farm at Ottawa. At a joint session of the agronomy, soils, and agricultural engineering groups, held in connection with this meeting, Mr. Hardy presented a paper on the subject of tillage machinery.

At a business session of the agricultural engineering group the following officers were elected for the ensuing year: Chairman, L. G. Heimpel, professor of agricultural engineering, McDonald College, Quebec; Vice-Chairman, Mr. Hardy; and Secretary, Mr. Armstrong.

Of particular interest to agricultural engineers in connection with this meeting is the appointment of three ASAE members—G. L. Shanks, associate professor of civil engineering, University of Manitoba; J. Macgregor Smith, professor of agricultural engineering, University of Alberta, and Mr. Hardy, as members of a regional committee on soil drifting which is an associate committee formed by the dominion government for the purpose of finding a long time solution of the drought situation which occurs at intervals in the prairie provinces.

ASAE Technical Division Changes Name

DURING the business session of the Land Reclamation Division of the American Society of Agricultural Engineers held in connection with the annual meeting of the Society at Athens, Georgia, last month, the Division voted to change its name to "Soil and Water Conservation Division." This change was aproved by a vote of the Council of the Society in session the same week, and henceforth this Division will be known by its new name.

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the June issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Ross C. Behymer, state administrator (ECW), Soil Conservation Service, U. S. Department of Agriculture. (Mail) 1300 Lydia St., Louisville, Ky.

J. Irwin Davis, Sr., district representative, Caterpillar Tractor Company. (Mail) 710 Second Ave., Albany, Ga.

W. B. Dykes, trainee, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 182 Wray St., Athens, Ga.

Joseph L. Hecht, vice-president, French & Hecht, Inc., Davenport, Iowa.

Hans G. Jepson, assistant agricultural engineer (acting chief engineer), Soil Conservation Service, U. S. Department of Agriculture. (Mail) Spencer, W. Va.

Robert C. Jones, assistant technician (ECW), Soil Conservation Service, U. S. Department of Agriculture. (Mail) Old Post Office Building, Spartanburg, S. C.

A. L. Kennedy, assistant agricultural engineer, agricultural division, Tennessee Valley Authority. (Mail) Box 144, Athens, Ala.

Staton McIver, acting assistant agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Wadesboro, N. C.

Lester A. Malkerson, J. I. Case Company, 4915 16th Ave., S., Minneapolis, Minn.

Robert A. Miller, assistant agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Rock Hill, S. C.

J. D. Pittman, president, J. D. Pittman Tractor Company, Inc., 520-30 N. 28th St., Birmingham, Ala.

John H. Ploehn, superintendent, French & Hecht, Inc., Davenport, Iowa.

Marshall E. Pruett, draftsman (ECW), Soil Conservation Service, U. S. Department of Agriculture. (Mail) Camp Hill, Ala.

Harold M. Rhodes, technical assistant (ECW), Soil Conservation Service, U. S. Department of Agriculture. (Mail) Spencer, W. Va.

H. C. Seaton, trainee, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 182 Wray St., Athens, Ga.

M. R. Seaton, trainee, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 182 Wray St., Athens, Ga.

George N. Sparrow, superintendent ECW camp, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Camp Hill, Ala.

Benjamin L. Taylor, chief agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 1908 23d Ave., Meridian, Miss.

James C. Tillman, trainee, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 370 S. Lumpkin St., Athens, Ga.

Stanley A. Witzel, assistant professor and extension agricultural engineer, agricultural engineering department, University of Wisconsin, Madison. (Mail) RFD No. 6, Mendota Beach.

North Atlantic Section to Meet at Cornell

THE NEXT yearly meeting of the North Atlantic Section of the American Society of Agricultural Engineers will be held at Cornell University, Ithaca, N. Y., October, 7, 8, and 9, with the agricultural engineering staff of the University as host for the occasion. It is of interest to note in connection with this event that the organization meeting of the Section was held just ten years ago at Cornell, in April 1925.

One of the features of particular interest to agricultural engineers in connection with this meeting will be a trip to Geneva, N. Y. (40 miles from Ithaca) for the purpose of unveiling a monument commemorating the laying of the first land drain tile in the United States just one hundred years ago. It is planned to open a section of the original drain for inspection. The tile was brought from Scotland and laid by John Johnston on his farm in 1835.

Agricultural Engineers Meet in Texas

THE SOUTHWEST Soil and Water Conservation Conference was held at Tyler, Texas, July 8 and 9, and inasmuch as a large number of agricultural engineers in the Southwest were to be in attendance at this meeting, the Southwest Section of the American Society of Agricultural Engineers scheduled a technical meeting for July 10 at the same place. The program of this meeting was featured by an address by the Society's new president, Mr. L. F. Livingston, manager, agricultural extension section, E. I. du Pont de Nemours and Company.

The following technical papers were also presented: "Design and Construction of Sodded Terrace Outlet Channels," by Howard Matson, Soil Erosion Service, U. S. Department of Agriculture, Lindale, Texas; "Selection of Proper Grades for Terraces in the Red Plains Region," by H. S. Riesbol, associate agricultural engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture, Guthrie, Oklahoma; and "Terrace Outlet Control in the Elm Creek Watershed of the Federal Soil Conservation Service," by H. O. Hill, chief agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture, Temple, Texas. The subject of rural electrification in the Southwest was also a feature of the program. Further details of the meeting will appear in the August AGRICULTURAL ENGINEERING.

Washington News Letter

THE following news of particular interest to the engineering profession is from the June 15 news letter of American Engineering Council, the Washington embassy of American engineers and engineering, of which the American Society of Agricultural Engineers is a member:

The executive committee meeting of Council in New York May 20 covered a wide field of professional subjects. The water resources committee report was approved. Two fundamental needs for a national water resources policy are named as (1) complete and correlated data and (2) comprehensive study of water control legislation. A federal bureau of water resources is endorsed in principle and an interdepartmental board of water resources investigations is recommended to correlate investigational functions of federal units. Extension of the work of the water planning committee is recommended through a national advisory water planning agency for comprehensive, integrated drainage basin planning.

As to legislation, it is pointed out that bills in Congress often stress the importance of water power beyond the other urgent needs for water; they also overlook the known facts which limit the economic development of available power sites. Intensive study by engineers is therefore desirable.

Opposition to the establishment of additional river basin authorities along the lines of TVA at the present time was adopted as a policy of Council.

Membership of state and local societies newly united with Council was approved; also the new Assembly members from these groups. It is planned to use the ECPD rating system in determining the eligibility of members of the Assembly. Procedure for handling new membership applications was simplified.

Cases are being studied where engineers who have qualified under civil service feel that the rating did not give them the guarantee of employment to which they are entitled. Arthur W. Berresford, past-president of AEC, has begun a preliminary survey of the general relationship of engineers to the civil service.

Boards of civil service appeals, to settle differences between federal civil service employes and their superiors, are proposed in the Sirovich Bill (H. R. 3980). On a three-man board to hear a given case, one member would represent the employe, one the Civil Service Commission, and one the federal unit involved in the dispute. An engineer could be represented by a delegate from his engineering society.

The Anti-Gasoline-Tax-Diversion Association has asked Council to support the idea of restricting gasoline taxes to highway purposes. The executive committee suggests that this will be a desirable project to refer to state public affairs committees when they are formed, but state and local societies need not delay action on their own initiative.

R. E. W. Harrison, chief, machinery division, U. S. Bureau of Foreign and Domestic Commerce, points out the need for engineering societies to draft a program which will serve to coordinate engineering thought with respect to problems of national scope confronting the durable goods industries. He suggests Council as a logical organization to provide executive direction toward such a program.

Numerous patent bills were considered and Council's opposition to the Sirovich Bill (H. R. 4523) for the registration of patent pooling agreements, previously voiced by the committee on patents, was confirmed by the executive committee.

Increased participation of engineers in public affairs is a theme upon which Council has been hammering for some time and one which is becoming recognized as a need throughout the profession. At a meeting of the American Society of Municipal Engineers and the International Association of Public Works Officials in Washington in May, Dr. Louis Brownlow stated that engineers should begin to think of their relationship to the combination of cities *and* counties *and* states *and* the United States rather than to the cities *or* counties *or* states *or* the United States.

As reported in previous letters, Council is working to this end through a plan which ultimately will result in the setting up of state and regional public affairs committees composed of key men in each area. Our system of membership committees, now rapidly developing to encourage state and local societies to join Council under the new plan of nominal dues, is a step toward the final network of organized groups. Each new member society is asked to appoint a man to keep us informed as to public affairs in his region, and we are working toward a complete set-up in one or two states in order to test the plan.

Meanwhile there is a preliminary phase in which all can help. It is our feeling that, if engineers really are to bear weight in public affairs, the field must be developed along lines of engineering analysis just as the technique of the profession has taken form over the past several decades. We now have an extensive literature of engineering technique so that a specialist in any branch of the profession may read the record of successful experience in relation to his problems.

But the equally broad field of public affairs has not been fully explored and charted by engineers. Council, therefore, is seeking to assemble material in an effort to build up a practical record of experience along this vital line of activity.

You can help by sending in your general observations as to the proper relationship of engineers to public affairs together with accounts of actual cases with which you are familiar. How have engineering societies acted to support legislation in the public welfare? How have they helped promote sound public projects and improvements in public administration? How have they gotten their story over to the public so that the function and accomplishments of engineers have been recognized in their proper scale? Sit down and write. We need the facts.

The New York meeting on May 20 of the group of functional units serving the profession as a whole brought these organizations into closer coordination than ever before. Details have been covered in the June issue of the founder society magazines, to which your attention is invited. The meeting drove home the fact that the functional units are a powerful influence toward the advancement of engineers, whether they reach directly to the individual or indirectly through the work of the national societies.

Council's exhibit featured a map of engineering organizations, national, state, and local, in the entire United States. When in final form, it will be prepared for distribution. You probably will be surprised, as we were, to see the number and the wide spread of professional organizations. Other exhibits of Council included publications which have been placed on permanent file at the Engineering Societies Library in New York.

The summary of the Brookings Institution reports, "America's Capacity to Produce" and "America's Capacity to Consume," furnished this office by courtesy of the Falk Foundation for distribution to engineers, has been in heavy demand. We secured a new batch; still have a few left for those who write before the supply is exhausted.

Agricultural Engineering Digest

(Continued from page 277)

[A FIVE-YEAR BIBLIOGRAPHY OF THE THEORY OF REFRIGERATION, REFRIGERANTS, AND APPLIANCES, 1929-1933, AND OF THE APPLICATIONS AND TESTING OF REFRIGERATION, AND OF ITS BRITISH PATENTS, 1929-1933], compiled by *H. T. Pledge*. London: Sci. Mus., So. Kensington, 1934, [pt. 1] pp. 97, [pt. 2] pp. 78. The first of these bibliographies is concerned chiefly with theory and appliances of refrigeration. The second deals with the applications of refrigeration and the testing of its effects.

THE MECHANICAL AERATION OF SEWAGE BY SHEFFIELD PADDLES AND BY AN ASPIRATOR, *H. E. Babbitt*. Ill: Engin. Expt. Sta. Bul. 268 (1934), pp. 56, figs. 21. Tests are reported the purpose of which was to measure the efficacy of the Sheffield paddle aerator and to study aspirating devices for aerating sewage in the activated sludge process of sewage treatment. An air diffusion aerator was used as a check upon some of the results obtained from the aspirator.

It was found that satisfactory activated sludge can be formed and an effluent of desired quality can be obtained by thorough agitation of sewage in shallow tanks by means of Sheffield paddles. Under proper conditions the method of aeration is highly satisfactory. Satisfactory aeration is obtained, with the lowest expenditure of power, by submerging the paddles from 6 to 9 in in the mixed liquor. Under-aerated and bulking sludge, a low biochemical oxygen demand modulus, mechanical difficulties, and inefficient pumping equipment all point to the conclusion that the circulation of sewage through an aspirator by means of a pump which must lift the sewage into the aspirator head is not a successful method of sewage treatment. Aeration of sewage through an aspirator is mechanically efficient and biologically and chemically satisfactory when the equipment is arranged with two or more aeration tanks and aspirators in series.

SOME TESTS OF LOAD CAPACITY OF FLOORS MADE WITH PRECAST CONCRETE JOISTS, *R. E. Copeland* and *P. M. Woodworth*. Jour. Amer. Concrete Inst., 5 (1934), no. 4, pp. 311-324, figs. 8. This is a progress report of an investigation of the structural performance of a floor construction consisting of precast reinforced concrete joists with cast-in-place or precast 2 or 2.5-in reinforced concrete slab.

The purpose and scope of the tests so far made are (1) investigation of the influence of proportions, consistency, type and grading of aggregate on placeability, strength, and appearance of the concrete; (2) tests on 27 specimens to determine the shearing strength at the joint with bond effected by different means; and (3) uniform loading of 12 panels 14 by 4 ft and 4 panels 14 by 2 ft to determine deflection at midspan, strains in concrete and tensile steel, and the general behavior of the panel with load increase.

This study and later experience in casting 32 joists 14 ft 8 in long demonstrated that satisfactory results can be obtained with hand spading and suitable concrete mixtures. Because of the greater shrinkage, however, with the wet consistencies, large amount of fine aggregate, and richness of mix necessitated by this method of placing, the use of mechanical means of compacting should receive consideration.

The tests of joint strength showed that joint strengths produced with concrete bond ranged from 280 to 340 lb per square inch of bonding area. Metal ties of any substantial type increase the joint strength remaining after fracture of the concrete bond. With the particular joist design investigated, the strength of joists with concrete bond may be expected to be from 5 to 6 times the horizontal shear allowed with plain anchorage and from 3.3 to 4 times the shear allowed with special anchorage.

The performance and results as to load capacity, deflection, and measured stresses of panels with slab and joist connected with a concrete bond, with or without metal ties, indicated sufficient joint strength and interaction between slab and joint as to permit the use of the usual flexure formulas and allowable working stresses for T-beams in the design of floors of this type. Panels with monolithic slab and concrete bond gave ratios of ultimate load capacity to maximum design live load of 85 lb per square foot, ranging from 2.8 to 3.7. With all panels tested the deflection at design load was substantially less than 1/360 of the span length. There appeared to be no great difference in performance or results with different types of reinforcements. Results and performance of panels with joists made with different type of concrete compared so closely as to indicate that the types of aggregate of the joist concrete is not an important factor. For the range of conditions studied, strength of slab concrete had no marked effect on the ultimate load capacity of the floor construction. While metal ties of the type used may be regarded as desirable supplemental connections, their use did not increase load capacity over that obtained with concrete bond alone.

DURABILITY OF PAINT ON WOOD TREATED WITH ZINC CHLORIDE, F. L. Browne. Amer. Wood-Preservers' Assoc. Proc., 30 (1934), pp. 410-430, figs. 3. The painting characteristics of wood treated with zinc chloride for preservation against decay were studied at the USDA Forest Products Laboratory by observation of practical installations and by a carefully planned series of exposure tests in which matched specimens of wood were used with and without treatment. For interior surfaces the presence of as much as 1.5 lb per cubic foot of zinc chloride in boards 1 in thick does not affect the behavior of interior flat or gloss paint significantly. For exterior surfaces it is entirely practicable to maintain zinc-treated wood with ordinary linseed oil paints, but the paints do not last so long on wood containing zinc chloride as they do on untreated wood. When wood treated with zinc chloride is primed with aluminum paint before applying ordinary white paint, the durability of the coating is greatly improved. Wood treated with a mixture of 2 parts of zinc chloride and 1 part of sodium dichromate by weight holds paint fully as well as similar but untreated wood. Since at least half of the zinc chloride in such a mixture must remain in the wood as such and whatever zinc dichromate is formed by the rest of the mixture is toxic in laboratory tests, the mixture offers promise as a wood preservative, although service tests to determine that point are lacking. The mixture of zinc chloride and sodium dichromate may be given serious consideration for uses in which preservation is necessary and maximum economy in paint maintenance is desired and where service records proving satisfactory effectiveness as a preservative are not considered essential.

THE DURABILITY OF MOLE DRAINS, *H. H. Nicholson*. Jour. Agr. Sci. [England], 24 (1934), no. 2, pp. 185-191, pls. 2. In a contribution from Cambridge University a statistical analysis is presented of data from 80 selected farms in an effort to correlate mole drain durability with the physical properties of the soils.

The data indicate that the physical constitution of the soils is the most potent factor in the deterioration of mole drains. Apparently the presence of even a few sandy or gravelly patches in the clay may be a cause of weakness in the whole system.

Studies of plaster casts of mole drains in clay soil showed that the plaster cast method is very useful in following and recording the changes and decay to which such drains are subject. It would appear that fissuring, the very factor which is most potent in ameliorating the drainage of heavy clays, is the chief cause of the decay of the mole channels. Whether these fissures are produced naturally by the drying out and the contraction of the clay or artificially by the disruptive effects of deep tillages or of mole draining, the effects are similar.

"Turning to the effects of mole draining operations, it would appear that the upheaval and tearing effect which is apparent as the mole plow proceeds is all to the good, to the extent to which it occurs between the soil surface and the mole channel. A comparatively permeable strip of soil is produced to about 18 or 24-in on either side of the mole slit, and this must make it easier for excess water at the surface to find its way into the mole channels. Fissuring in the walls of the channel itself, however, cannot be so favorably regarded, as it must be a cause of weakness and of earlier collapse of the walls. It would appear that such fissuring may be due to various causes. The presence of small stones or gravel in the clay subsoil is undoubtedly one, while another is the angle which the cartridge makes with the surface of the soil. The greater this is the more numerous and substantial are the fissures in the wall of the channel."

AN ELECTRICAL PLOUGHING TEST. Impl. and Mach. Rev., 60 (1934), no. 714, pp. 503, 504, figs. 2. The results of Italian tests of two electrical plowing outfits, both of the cable type, are reported briefly. Apparently the outstanding defect is the low plowing capacity so far attainable of only about 1/20 acre per hour.

WATER CONTROL INVESTIGATIONS UPON THE FLATLANDS OF THE FLORIDA EVERGLADES, *R. V. Allison* and *B. S. Clayton*. Florida Sta. Rpt., 1933, pp. 172, 173. The progress results are briefly reported of studies of water level in observation wells and on the installation of a detailed set-up for water table studies. This work is being conducted in cooperation with the USDA Bureau of Agricultural Engineering.

(Continued on page 286)

Trash Shields for Plows

(Continued from page 260)

In addition to corn borer control, it is pointed out that the value of clean plowing and complete crop residue coverage cannot be overemphasized as a possible means of controlling or aiding in controlling many other destructive insect pests and troublesome weeds.

Clean plowing is recognized as a good farm practice regardless of insect pest control, as it aids materially in controlling weeds and eliminates much difficulty from trash clogging tillage implements throughout the season.

Agricultural Engineering Digest

(Continued from page 284)

FORCING GLADIOLUS OUTDOORS BY HEATING THE SOIL WITH ELECTRICITY, *J. R. Tavernetti* and *S. L. Emsweller.* California Sta. Bul. 584 (1934), pp. 14, figs. 8. The results of a series of experiments conducted during the winter and spring seasons of 1931, 1932, and 1933 are reported, the purpose of which was to determine the effect and costs of this method of forcing outdoors.

The first year plants were grown in an uncovered frame, the second in the open field, and the third in a covered frame. The corms used in all the experiments were between 1.5 and 2 in in diameter. The soil was warmed by a special heating cable consisting of a resistance wire insulated with felted asbestos and enclosed in a lead sheath about 0.25 in in diameter. This cable had a resistance of 0.5 ohm per foot and was connected to a 110-v circuit.

In the tests with the uncovered frames with two varieties of gladiolus the growth in the heated bed was always considerably more advanced than in the check bed. At first the foliage was a light green, but as the season advanced it became normal and the quality of flowers produced was in no way inferior. In the heated bed both varieties began to bloom about 2 weeks earlier than in the unheated and had finished before 25 per cent of the latter had bloomed.

In the open field tests with six varieties, 8 beds, each 18 in wide and 26 ft long, were used, 4 being heated and 4 unheated. Three varieties were exposed to 60 and 102-day periods of heating. In each instance those varieties receiving the shorter periods of heat began blooming before as soon as those receiving the maximum amount. In all varieties the unheated corms began to bloom from 10 to 22 days later than the heated.

In 1933 the plantings of five varieties were made in four 6 by 30 ft outdoor frames, 3 of which were heated and 1 unheated. During the first 9 weeks of the heating period all of the frames were covered at night and on cloudy days by sash made of wax-impregnated muslin.

The results obtained in the covered frames were in complete accord with those secured in the uncovered and open field beds. They also indicated that the beneficial effect of soil heating was in the early stages of growth and that continuous heating was not necessary. In each instance the heated plats began blooming first and at practically the same date. The time required, however, for 75 per cent of the plants to bloom was considerably shorter on the plats heated 91 and 63 days than on the one heated for 35 days. All varieties except one showed a more favorable response to the 63-day period. In practically all varieties 75 per cent of the heated corms had been cut before 25 per cent of the unheated were harvested.

The results in general showed that the time required for gladiolus to bloom was shortened from 2 to 6 weeks by heating the soil with electricity to a temperature of between 60 and 70 deg F. Heating for about 60 days gave as good results as heating for about 100 days—in some cases better. Heating for 35 days was beneficial but did not give as good results as heating for 60 or 100 days. The quality and number of spikes produced was not affected by heating the soil.

The cost of heating the soil depends upon the temperature maintained and the method of planting. With electricity at 2 cents per kilowatt-hour the cost of heating the soil in an uncovered frame was 2.4 cents per square yard per day for maintaining a temperature about 16 deg above normal. In raised beds in the open field the cost of heating was 3.9 and 2.1 cents per square yard per day for increasing the temperature 16 and 11 deg, respectively. In frames covered with wax-impregnated muslin the cost of heating was about 2.5 cents per square yard per day for increasing the temperature 20 deg. *(Continued on page 288)*

Agricultural Engineering Digest

(Continued from page 286)

WATER SUPPLY, IRRIGATION, AND DRAINAGE INVESTIGATIONS AT THE UTAH STATION. *W. Peterson, G. D. Clyde, O. W. Israelsen, W. Gardner*, and *D. S. Jennings*. Utah Sta. Bul. 250 (1934), pp. 51, 58-60. The progress results are briefly presented of studies of underground water resources, relationship of stream discharge to precipitation with special reference to forecasting the supply of water for irrigation from seasonal surveys of snow cover on mountain watersheds, factors which influence the reclamation of waterlogged and alkali lands, factors influencing the financial condition of certain Utah irrigation and drainage projects, water application efficiencies in irrigation and their relation to irrigation methods, and physical and physico-chemical properties and processes in soils.

MICHIGAN FARM HOMES, *C. H. Jefferson*. Michigan Sta. Spec. Bul. 251 (1934), pp. 43, figs. 49. The purpose of this bulletin is to present a number of carefully prepared farmhouse plans, together with a brief discussion of some of the most important building problems so that many of the frequent mistakes may be avoided by the prospective builder. Information on home furnishings by F. Gilmore and on landscaping the farm home by O. I. Gregg is also included.

HEAT ECONOMY AND COMFORT IN THE HOME AS INFLUENCED BY HEATING METHODS AND BUILDING CONSTRUCTION, *F. L. Lawton*. Engin. Jour., 17 (1934), no. 11, pp. 482-493, figs. 14. A large amount of data from various sources is presented relating to economy and comfort as influenced by heating methods and house construction. Special attention is drawn to the value of windows having a southern exposure, weather stripping, and insulation, and to the advantages of hot air, hot water, and steam-heating systems when properly installed.

EMPLOYMENT BULLETIN

An employment service is conducted by the American Society of Agricultural Engineers for the special benefit of its members. Only society members in good standing are privileged to insert notices in the "Positions Wanted" section of this bulletin, and to apply for positions advertised in the "Positions Open" section. Non-members as well as members, seeking men to fill positions, for which members of the Society would be logical candidates, are privileged to insert notices in the "Positions Open" section and to be referred to persons listed in the "Position Wanted" section. Notices in both the "Positions Wanted" and "Positions Open" sections will be inserted for one month only and will thereafter be discontinued, unless additional insertions are requested.

POSITIONS WANTED

AGRICULTURAL ENGINEER, graduate of professional course, desires research and teaching position in state college. Prepared to teach a course in soil erosion control as well as other phases of land reclamation and farm power and machinery. Experience in research and educational work and administrative and field work. Now employed. Salary $3000. PW-263

POSITIONS OPEN

RESEARCH FELLOW in the field of farm structures wanted. Research work involved will be related in some definite way to the use of ceramic materials in the construction of farm buildings. The holder may take a full graduate program of work leading toward an advanced degree. Candidates must be graduates from a standard agricultural engineering curricula and, unless waived, must be in the upper one-fourth of their classes in scholarship. The stipend is $450 for nine months. PO-103

RESEARCH FELLOW in the field of mechanical farm equipment wanted. The conditions and stipend are the same as above (PO-103), except that the research work will be related to mechanical farm equipment. PO-104

INSTRUCTOR IN AGRICULTURAL ENGINEERING. Instructorship is in the field of mechanical farm equipment, but the holder will be expected to assist with shop instruction. A candidate looking forward to making educational work a life career will be given special consideration. Some graduate study will be permitted. The salary will be $1200 to $1500 for nine months. PO-105

AGRICULTURAL ENGINEERS competent to assume responsibility for gully control work, terracing, or other engineering work which may be necessary on sub-projects, are wanted on one of the Soil Erosion Service projects. Mature men are desired who are capable of supervising the work of camp engineers and also of younger engineers employed on the job. PO-106.